MONTANA DEPARTMENT OF TRANSPORTATION
ROAD DESIGN PROJECT DEVELOPMENT
GUIDELINES

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SURVEY

GENERAL

1. The Consultant will be responsible for completing all engineering and cadastral survey work necessary for the Project. All survey work will be accomplished under the direct supervision of a professional land surveyor licensed in the state of Montana and in conformance with the Department's Survey Manual and the procedures for a Control Traverse System, Control Traverse Diagram and Plotting, and Property Corner Ties.

Before any survey work is started, the Consultant will meet with the appropriate Department personnel to review and discuss the work.

2. All surveys will utilize the Montana state plane coordinate system. Global Positioning System (GPS) surveying methods, if used, will meet the requirements of GPS Survey Requirements.

3. Either conventional surveys or photogrammetric mapping methods may be used. All electronic files must be developed in Microstation. Translation from any other platform including any exchange files will not be acceptable.

4. The Consultant will survey and monument the Control Traverse for the Project. The Consultant will tie photogrammetric ground control to the control traverse, both horizontally and vertically.

5. Field pickup surveys will be provided as necessary to locate and identify topography and utility verifications. Pickup surveys will be tied to the established control traverse.

6. The Consultant will provide all hydraulic surveys.

7. The Consultant will provide all surveys necessary to confirm the aerial mapping. This will include conducting field surveys at the intersections at the ends of the Project to confirm elevation matches into the existing adjacent streets. The Consultant will also field verify the aerial mapping (to confirm quantity volumes) by surveying three random cross-section checks in the field to compare with the cross sections developed by aerial mapping. Full coordinates (x, y, and z) will be computed by the Consultant for each point on each ground cross-section line. The ground cross sections and the map cross sections will be plotted and compared to verify the mapping accuracy.

8. The Consultant will survey and locate all existing public and private utilities in the Project corridor above and below ground. All underground utilities will be located by a Subsurface Utility Engineering (SUE) firm approved by the Department, and all such location work will be in accordance with the Department's criteria, which are covered in the Subsurface Utility Engineering Section.

The Consultant will perform a Phase I SUE survey as a part of the initial scope of this Agreement. A Phase II SUE survey, if required, will be performed by the Consultant as an additional cost item.

9. The Consultant will provide surveys for the relocation and/or reestablishment of section corners and property corners as necessary to determine ownership boundaries and acquire right-of-way on the Project. This includes making all the necessary ties to the Control Traverse and providing all necessary supporting documentation (see “Section Corner Relocation” Section for general requirements).

Retracement survey, including a Certificate of Survey, of the existing existing right-of-way is required when existing right-of-way is to be utilized and where new right-of-way is to be tied into the existing right-of-way. These corners and monuments are to be shown on the right-of-way plans. Wherever a section line crosses the centerline, the appropriate section corner on each side will be tied into the control traverse. All surveys involving section corners, property

corners, and right-of-way monumentation will be performed by a PLS and in accordance with the MDT Survey Manual.

10. Ties to railroad property will be required where railroad right-of-way is required.

11. The Consultant will secure right-of-entry permits and permission to survey, as necessary. If a property owner refuses permission to survey or requests payment of a permit fee, the Consultant will immediately advise the Department, and the Department will obtain permission or a judicial order allowing the survey.

12. The Consultant will survey and reference the final design centerline. All controlling points, P.T. and P.C. on simple curves, T.S., S.C., C.S., and S.T. on spiral curves, and sufficient points along the tangents to maintain intervisibility (150 m) for the length of the Project will be monumented and referenced.

13. The Consultant will compute full coordinates (x, y, and z) for the control traverses and design centerline, and for all right-of-way breaks. These coordinates will be placed on the appropriate plans.

14. The Consultant will provide all signing necessary for traffic control during survey work in accordance with the requirements of the MUTCD.

SECTION CORNER RELOCATION

The Consultant will be responsible for all section corner reestablishment and ties to the Project.

The scope of work for section corner reestablishment and property ties is as follows:

1. All work will be performed under the supervision of a land surveyor registered in the State of Montana.

2. The Consultant will make a thorough search for all property controlling corners along the Project. After the search is complete, a meeting between the consultant's land surveyor and the Department will be held to determine the corners that will need to be tied to the control traverse. The decisions will be based upon right-of-way requirements and ownership.

3. The required lost or obliterated corners will be reestablished in accordance with the provisions of Montana law.

4. All corners will be recorded in conformance with the Corner Recordation Act of Montana. Corner forms will describe the methods used to reestablish the corners. The consultant will furnish the department a copy of all corner recordation forms as recorded.

5. All found stones, posts, unmarked monuments, and reestablished corners will be monumented with 33"x30" flared base monuments and witnessed with a post and sign or yellow tag. The department will furnish the monuments. Existing monuments that clearly can be identified (i.e., BLM brass caps) and are in good condition do not need to be remonumented.

6. A search for all existing property corners (individual tract boundaries) along the Project will be made. Ties will be made to all found corners using the property tie procedure. A complete description of the found monument will appear in the notes and be shown on any drawings. Missing property corners will not be reestablished.

7. Closed traverse methods, with a minimum of two sets of horizontal angles, will be used to tie all corners.

8. Survey notes will be kept in a field book on a size of sheet and form acceptable to the Department.

9. A control diagram drawn to scale showing the traverse sequence and the corner locations will be provided. The point identification will match the field notes and computations.

10. The raw traverse, compass or least squares adjusted traverse and a listing of the corner coordinates will be provided in a format acceptable to the Department.

11. Lost or obliterated quarter corner positions that will fall within the existing paved highway will not need to be remonumented, but reference monuments will be established outside the proposed construction limits. A recordation form will be recorded.

12. If a single section line tie is required, the record and found bearings and distances between corners will be shown on the appropriate corner recordation form.

13. If more than one section line is required, a Certificate of Survey using as many sheets as necessary to clearly show all record and found bearings and distances, found and set controlling property corners, and method used to reestablish controlling property corners will be filed with the appropriate County Clerk and Recorder. A reproducible and two copies will be provided to the Department. The Department will review the Certificate of Survey prior to filing.

14. On projects with a control traverse, all property corners will be tied to the control traverse. If the consultant is preparing R/W plans, the coordinates of the property corners will be shown or listed on the drawings. The Department will provide monuments (2" diameter Aluminum Control Traverse caps with e" rebar, and 52' witness posts with signs) for control traverse points. The Consultant will use an approved rebar drive cap for monument rebar placement. An approved drive cap is the SURV-KAP issue RB-5/8 or an equivalent.

15. On projects with only a staked baseline (centerline), ties to the baseline control points will be made in the vicinity of the section line crossings. The station of the crossing and distances to the corners from the crossing will be computed. A sketch showing each crossing will be provided. The crossing information will not be shown on the corner forms or Certificate of Survey as the baseline may not be the final design line.

NOTE: Refer to the control traverse procedure for definition of terms used in this scope of work.

GPS SURVEY REQUIREMENTS

Global Positioning System (GPS) surveying is a relatively new and rapidly improving technology. The Montana Department of Transportation (MDT) recognizes the potential benefits of GPS technology for Department surveys. As such the MDT is beginning the process of developing a set of GPS survey standards and specifications for MDT surveys. Until these are completed and implemented, the MDT has elected to allow GPS surveys to be conducted for the department on a case by case basis as follows:

1. A written request detailing the proposed GPS Survey will be made and submitted to the Photogrammetry & Survey Section in advance of conducting the survey. The request shall address: GPS equipment to be used, vertical and horizontal control to be used, and baselines to
be observed.

2. Prior to commencement of the survey, the Photogrammetry & Survey Section will review and approve the plan or request that modifications be made to the plan to assure that desired results can be achieved.

3. Upon completion of the survey all compiled data will be submitted for review. As a minimum the submittal shall include an overview of the survey, description of all submitted data, project maps identifying baselines, mark descriptions, and observation log sheets. Post processed GPS data shall be processed using the latest version of Trimble's GPSurvey or the latest version of Trimble Gramatics Office. This data shall be archived on disk and submitted to the Photogrammetry & Survey Section for review.

4. The Photogrammetry & Survey Section will review the submitted data. The MDT will advise the consultant of results of the review.

5. B order and first order GPS surveys done for the MDT for the purposes of densifying Montana's High Accuracy Reference Network(HARN) shall conform with "Input Formats and Specifications of the National Geodetic Survey (NGS) Data Base" as set forth by the Federal Geodetic Control Subcommittee(FGCS). These specifications are commonly referred to as the "blue book". The consultant will be responsible for all submissions to NGS.

SUBSURFACE UTILITY ENGINEERING

GENERAL

1. The Consultant agrees to perform the required professional subsurface utility engineering services, including the obtaining of field subsurface utility data necessary to prepare right-of-way, utility, and construction plans for this Project in accordance with these requirements and utilizing the level of care as specified below.

2. The Consultant, employing qualified, competent, and experienced personnel, will perform subsurface utility engineering services in two phases.

3. The first phase designate (Phase I) consists of the Consultant's designating services. For the purposes of this Agreement, "designate" means to establish by engineering, surveying, and drafting practices the presence and horizontal location of subsurface utilities using geophysical prospecting techniques, including, without limitation, electromagnetic and sonic techniques within a 0.46 meter (18") tolerance. The term "designate" for the purpose of these instructions will also mean to establish by engineering, surveying, and drafting practices the horizontal and vertical location of above-ground utilities.

4. The second phase, locate (Phase II), consists of the Consultant's locating (test hole) services. For the purposes of these instructions, "locate" means to establish by engineering, surveying, drafting, and vacuum excavation practices the accurate horizontal and vertical position of subsurface utilities. The Consultant will provide the Department with a written log of each test hole. The Department will approve the number, if any, of excavations that will be performed by the Consultant.

5. All traffic control necessary will be performed in accordance with the *Manual on Uniform Traffic Control Devices*.

SUBSURFACE UTILITY DESIGNATING SERVICES

CONSULTANT responsibilities (Phase I) are as follows:

1. Provide all equipment, personnel, survey, traffic control, and supplies required to perform designating services. The CONSULTANT will determine what equipment, personnel, and supplies are required to perform designating services.

2. Conduct appropriate records research, investigate site conditions, and identify applicable project limits.

3. Obtain all necessary permits from city, county, or other municipal jurisdictions to allow the CONSULTANT to work in existing streets, roads, and/or on adjacent rights-of-way, including landowner permission.

Contact the Department District Administrator and utility companies 48 hours prior to beginning work to advise of and coordinate the work.

4. Designate the location of existing underground utilities including their major laterals and any overhead utilities that are within the project limits. Unless expressly requested, the Consultant will not be required to designate or record storm sewers, empty or abandoned utilities, and vault or manhole limits or dimensions.

5. All utilities will be tied to project centerline or base line with distance and station. Each underground utility must be electronically designated, surveyed, and mapped to within a tolerance of .46 meter (18") at 20-meter intervals when parallel to project centerline or base line,

at all direction changes and all closures, cabinets, and huts. Underground utility crossings must be designated, surveyed, and mapped at project centerline and at the outer project limits (proposed right-of-way line when known). Each pole or structure of overhead utilities within the project limits will be surveyed to centerline and mapped. A clearance on all overhead crossings to centerline will be measured and mapped with a centerline station.

6. Draft survey information in a plan format acceptable to the Department using Computer Aided Drafting and Design (CADD – Microstation) systems of the Consultant. All survey work, including the retracing of a survey centerline or base lines, will be determined and performed by the Consultant.

7. Compare survey information drafted on base plans using CADD with information provided from field data and evaluate all drafted information for accuracy and reliability.

8. Review and correct all plan sheets against all records, field sketches, CADD drafting, and field notes.

9. Unless otherwise directed by the Department, translate survey data and drafting codes to an electronic file to allow direct incorporation of the Consultant's digital survey information into the Department's design file.

10. Review and seal all appropriate work products by a staff Professional Engineer and/or Land Surveyor (licensed in the State of Montana) who is in charge.

11. Return base plans (and project diskettes) to the Department and review the information obtained with the Department.

12. Provide the Department a summary sheet showing the individual lineal meters of each utility company's facility designated for a project.

SUBSURFACE UTILITY LOCATING (TEST HOLE) SERVICES

CONSULTANT responsibilities (Phase II) are as follows:

1. The Consultant shall submit his plan for Phase II services for review by the Department prior to beginning the work. The plan must show the planned number and locations of proposed test holes.

2. Provide all equipment, personnel, traffic control, survey, and supplies required to perform its locating services.

The CONSULTANT shall determine what equipment, personnel, and supplies are required to perform such services.

3. Conduct appropriate records research and investigate site conditions.

4. Contact the utility companies 48 hours in advance and one call to advise and coordinate CONSULTANT activities.

5. Obtain all necessary permits from city, county, or other municipal jurisdictions to allow the Consultant to work in existing streets, roads, and rights-of-way. Obtain permission of private property owners.

6. Electronically sweep underground utility facilities.

7. Excavate test holes to expose the utility and measure to both top and bottom in such a manner that ensures the safety of the excavation and the integrity of the utility. In performing such excavations, the CONSULTANT shall comply with all applicable utility damage prevention laws and notify the Department District Administrator and utility company 48 hours in advance of beginning work. The Consultant shall be responsible for any damage to a utility company facility during the locating phase (Phase II).

8. Survey and record (a) horizontal and vertical location of top and bottom of utility referenced to project datum, (b) elevation of existing grade over utility at a test hole referenced to project datum, (c) outside diameter of utility and configuration of non-encased, multi-conduit systems, (d) utility structure material compositions, when reasonably ascertainable, (e) benchmarks and/or project control used to determine elevations, (f) paving thickness and type, where applicable, (g) general soil type and site conditions (h) record any soil contamination and (i) such other pertinent information reasonably ascertainable from the test hole site. References to project datum shall maintain vertical tolerances to ?.015 meter (05') based on benchmarks shown on the Consultant work product and horizontal tolerances to applicable surveying standards. If control points or additional benchmarks are required, the Consultant shall perform such services according to established practices at Consultant cost.

9. Provide permanent restoration of the pavement within limits of the original cut, including backfill and compaction methods acceptable to State. When test holes are excavated in areas other than a roadway pavement, these disturbed areas shall be restored as nearly as reasonably possible to the condition that existed prior to excavation.

10. Evaluate and compare obtained information with utility information described in utility records and resolve conflicts.

11. Draft the horizontal location and the profile view of the utility on project plans in a format acceptable to the Department.

12. Compile information described in Item #8 above using the Consultant's automated systems and quality assurance procedures. The CONSULTANT will provide the Department a test hole data sheet for each excavation.

13. Upon request, review data obtained with the DEPARTMENT.

WORK ZONE TRAFFIC CONTROL

1. When performing field work on or adjacent to public streets or highways, it shall be the responsibility of the CONSULTANT to provide traffic control devices (signs, cones, etc.) or other necessary devices, in accordance with the *Manual on Uniform Traffic Control Devices* (MUTCD) for designating (Phase I) or locating (Phase II) work.

WORK STANDARDS

1. Field data shall be obtained in conformity with current practices of the Department as outlined in various Unit Manuals and Unit Guidelines in regard to presentation, media, sheet sizes, scales, special drawings, and summaries thereof.

2. All original calculations, field notes, quantity calculations, boring logs, subsurface utility data, any necessary project special provisions, and other material in addition to the drawings prepared under this Agreement shall be the property of the Department and shall be turned over to the Department upon completion of the work.

REPRODUCTION

1. The Consultant shall be responsible for reproduction of all plans as necessary to complete the work of the Consultants.

SUBCONTRACTS

1. The Consultant shall not sublet any portion of the work under this agreement without prior approval by the Department.
2. The Consultant shall be responsible for the schedule of any work sublet to others so as to ensure that the overall schedule of the project is maintained.
3. The Consultant shall be responsible for the completeness, accuracy, presentation, inclusion of data into the design and plans, and reviews of any work sublet to others.

PERFORMANCE

1. The Consultant shall perform the subsurface utility engineering services set forth herein by providing services equal to or better than the practice prevalent within the subject area of the work and commensurate with the magnitude and intricacy of the work under consideration. Such services shall be so complete that it will not be necessary for the Department to supplement any of the operation by its own personnel.

AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRIC MAPPING REQUIREMENTS

SECTION 1 – AERIAL PHOTOGRAPHY

TYPES OF AERIAL PHOTOGRAPHY

MDT shall specify the type of aerial photography to be taken and the type of film to be used. Types of aerial photography to be requested shall fall under one of the following classifications:

- ?? vertical photography for reconnaissance purposes
- ?? vertical photography for mapping and measuring purposes
- ?? vertical photography for interpretive or illustrative purposes
- ?? oblique photography for interpretive or illustrative purposes

AREA OF PHOTO COVERAGE

Areas to be photographed shall be outlined on maps, aerial photos, or shall be otherwise described by the MDT.

AERIAL CAMERA

Only precision aerial cameras and magazines shall be used. The most current USGS calibration report shall be submitted to MDT's Photogrammetry & Survey Section Supervisor prior to photo acquisition. MDT reserves the right of final approval of any combination of camera equipment proposed for use based on desired results.

Calibration

Only precision aerial cameras and magazines that have been calibrated by the United States Geological Survey (USGS) camera calibration laboratory within three (3) years of photo acquisition shall be used. Calibration reports shall include calibration results for any film magazines to be used with the camera. Only those combinations of cameras and magazines shown on the calibration report shall be used to take aerial photographs. If there is any reason to believe the dimensional

relationship of the lens, fiducial marks, and/or film plane have been disturbed by partial disassembly or unusual mechanical shock, the camera must be submitted for recalibration at the consultant's expense prior to use.

Focal Length

The focal length of the camera lens shall be 153 mm ± 3 mm. Use of aerial cameras with other focal lengths will be subject to approval by MDT's Photogrammetry & Survey Section Supervisor.

Film Format

The format of the photography shall be 9 inches by 9 inches square, with at least a one-quarter inch margin between the photo and the edge of the film.

Shutter

The camera shall be equipped with a between the lens shutter of the variable speed type. The range of speed settings shall be such that for all anticipated combinations of flight heights, aircraft speeds, film speeds, and light conditions, the camera will produce high-resolution photographs.

Platen

The camera shall be equipped with a vacuum or pressure device for flattening the film at the instant of exposure. The platen against which the film is pressed at the instant of exposure shall not depart from the true plane by more than 13µm.

Resolution

The resolution of the camera will be evaluated based on an Area-Weighted Average Resolution (AWAR). The minimum requirement will vary based on specifications of mapping equipment proposed for use along with planned uses for the photography. In general the MDT is looking for an AWAR equivalent to or exceeding 90 line pairs per mm.

Filter

Only glass filters with metallic antivignetting coating shall be used to reduce the illumination for uniform distribution of light over the focal format. The surface with the antivignetting coating shall be toward the camera lens. The filter shall have surfaces parallel within 10 arc seconds, and its optical quality shall be such that its addition to the camera shall enhance the uniformity of focal plane illumination and not cause an undesirable reduction in image resolution.

Port Glass

If an aircraft camera has port glass, it shall be at least 50 mm thick. The surface finish shall be 80/50 or better. Glass material shall be polished crown, group category M, Mil Specs Mil-W-1366f (ASG) October 1975, C-1 optical quality or better.

The camera window shall be mounted in material eliminating excessive mechanical stress to the window. The opening shall be designed so that the field of view is unobstructed when the camera is mounted.

Fiducials

The aerial camera shall include a minimum of eight fiducial markers. These must be located in or near the four corners and in or near the center of the four sides of the focal plane opening. The lines joining opposite pairs of fiducial markers must intersect within a 0.030 mm radius circle around the principal point of autocollimation. The calibrated principal point shall fall within a 0.015 mm radius circle around the principal point of autocollimation.

Forward Motion Compensation

Magazines designed to provide film movement during exposure at such a rate as to compensate for the movement of the photographic images shall be used.

Stabilized Mount

It is recommended that a gyroscopic stabilizer be incorporated within the mount structure of the camera to support the camera in a level position and function as a vibration damper.

MISSION/FLIGHT PLANNING

Photo missions shall be designed to produce quality aerial imagery. The consultant shall be responsible for any details of the flight planning not specified by the MDT.

Flight Plan

Prior to executing a photo mission the consultant shall provide a detailed flight plan for acquisition of aerial photography to MDT's Photogrammetry & Survey Section Supervisor for approval. The flight plan shall be on a map or set of aerial photo and shall show applicable items including: proposed flight line locations, photo coverage extents, proposed mapping extents, ground control locations, flight height, photo scale, project location (latitude/longitude), and endlap/sidelap requirements. The mission shall be executed according to the approved flight plan.

Extents of Photo Coverage

The consultant shall develop a set of flight plans showing proposed photo coverage limits along with photo limits requested by the MDT. When planning photo limits the consultant should take into consideration the fact that it may be desirable to extend aerial photo coverage beyond the areas initially identified.

Flight Height

If not provided by the MDT the consultant shall propose a flight height and negative scale. When proposing negative scales consideration shall be given to camera resolution, scanning and stereoplotting equipment to be used, and requested map scales/accuracies. The MDT reserves the right to reject the proposed scale if, in the MDT's opinion, the scale is not suitable for meeting project requirements.

Ground Control

Proposed locations for ground control points shall be shown on the flight plan. Enough ground control shall be established to achieve desired accuracies and provide for adequate checks. Excessive amounts of ground control shall be avoided.

Placement of ground control points and targets for aerial photography shall be the consultant's responsibility. General guidelines for target placement are as follows:

- Ground control points for photography shall be permanently monumented with a rebar and MDT control cap or PK nail as outlined in the MDT survey manual.
- Numbering of photo control points shall be as outlined in the MDT survey manual.
- Recommended target sizes and shapes are shown on the standard targeting diagram (figure 1).
- Target centers must correspond precisely with control monuments (there shall be no horizontal or vertical offsets).
- Photo control points shall be placed in safe locations, on flat preferably level ground, and in areas free from obstructions and/or shadows.
- Vegetation shall be cleared from underneath the target areas so the target rests as close as practical to the ground.
- The consultant shall provide recovery descriptions in an ASCII text file for all photo control points established by the consultant.
- A set of contact prints with the locations of each photo control point identified thereon shall be provided to the MDT after acquisition of mapping photography.

The MDT shall be responsible for surveying and providing coordinate information of ground control points to the mapping consultant.

Spacing of Photography

Photos for mapping purposes must contain enough overlapping photography to provide stereoscopic coverage. Flight plans shall indicate the amount of endlap and sidelap to be provided.

Endlap shall average not less than fifty-seven (57) percent or more than sixty-two (62) percent. Endlap of less than fifty-five (55) percent or more than sixty-eight (68) percent in any pair of photographs may be cause for rejection of the photographs in which such deficiency or excess of endlap occurs unless, within a stereoscopic pair, endlap exceeding sixty-eight (68) percent is necessary in areas of low elevation to attain the minimum fifty-five (55) percent endlap in areas of higher elevation.

Sidelap shall average twenty-five (25) percent plus or minus ten (10) percent. Photographs having sidelap less than fifteen (15) percent or more than fifty (50) percent may be rejected.

All photography shall extend at least two full photos past the end of a flight line.

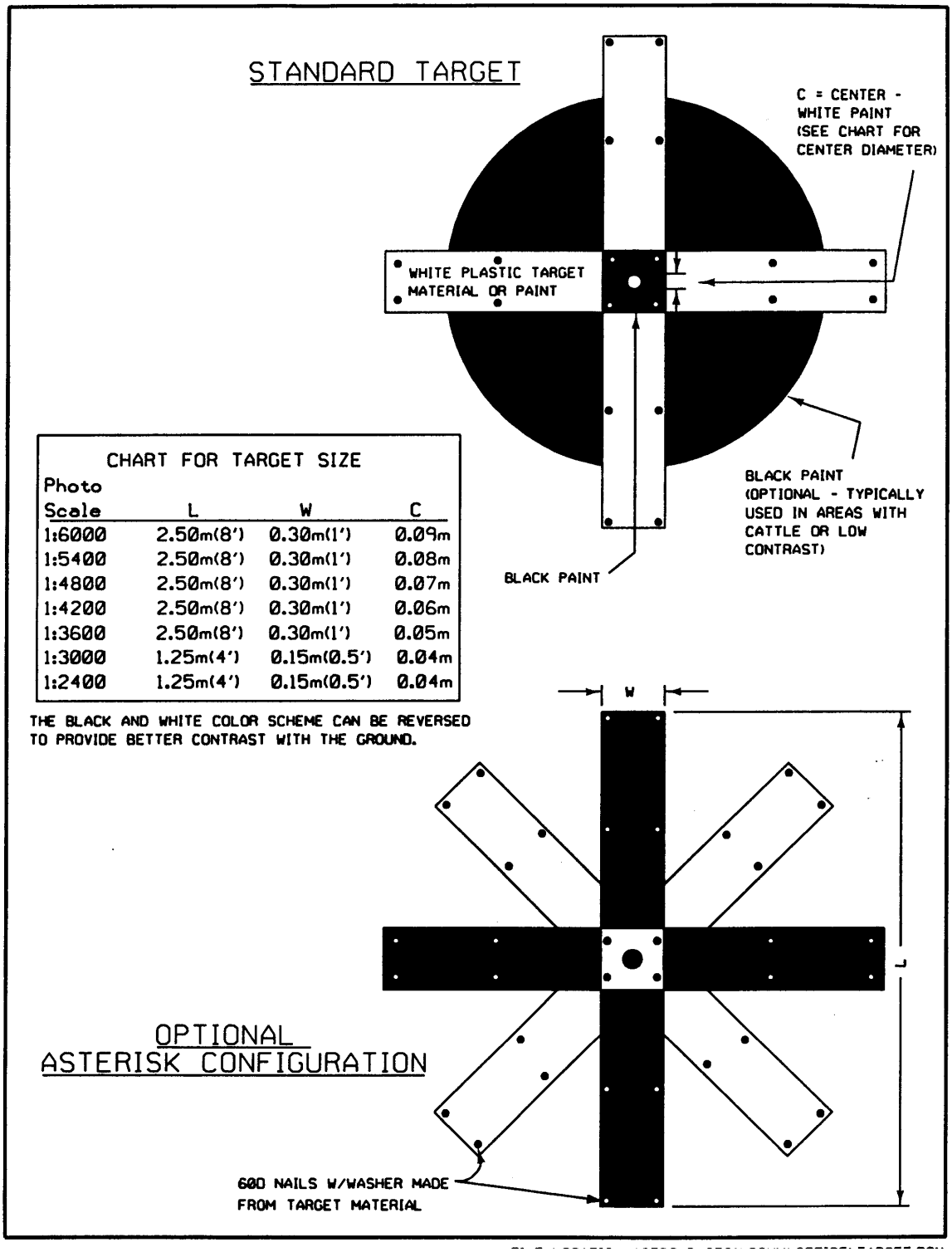
STANDARD TARGET
C = CENTER - WHITE PAINT (SEE CHART FOR CENTER DIAMETER)
WHITE PLASTIC TARGET MATERIAL OR PAINT
BLACK PAINT (OPTIONAL - TYPICALLY USED IN AREAS WITH CATTLE OR LOW CONTRAST)
BLACK PAINT
CHART FOR TARGET SIZE
Photo Scale | L | W | C
1:6000 | 2.50m(8') | 0.30m(1') | 0.09m
1:5400 | 2.50m(8') | 0.30m(1') | 0.08m
1:4800 | 2.50m(8') | 0.30m(1') | 0.07m
1:4200 | 2.50m(8') | 0.30m(1') | 0.06m
1:3600 | 2.50m(8') | 0.30m(1') | 0.05m
1:3000 | 1.25m(4') | 0.15m(0.5') | 0.04m
1:2400 | 1.25m(4') | 0.15m(0.5') | 0.04m
THE BLACK AND WHITE COLOR SCHEME CAN BE REVERSED TO PROVIDE BETTER CONTRAST WITH THE GROUND.
W
L
OPTIONAL ASTERISK CONFIGURATION
60D NAILS W/WASHER MADE FROM TARGET MATERIAL

Figure 1

Conditions

Photography shall be taken under the best possible conditions for obtaining well defined images. Photography shall not be attempted when the ground is obscured by haze, smoke, dust, or blowing sand; or when clouds or shadows from clouds may appear in the photography. Photography shall be taken outside retro-reflective times and when the sun angle is 30 degrees or more above the horizon.

Tolerances

Crab can result in diminished or excessive sidelap or endlap or possibly gaps in photograph coverage. Crab in excess of 3 degrees may be cause for rejection of a flightline or any portion thereof in which the crab occurs.

Tilt turns the photographed image into a parallelogram rather than a square and increases the range of scale differences in the image and between adjacent photographed images. Tilt of the camera from verticality at the instant of exposure shall not exceed 3 degrees. Overall tilt change between successive exposures shall not exceed 5 degrees. Average tilt over the project shall not exceed 1 degree. Images outside these parameters may be rejected.

Photographs taken from a flight height more than 2% lower or 5% higher than the design flight height may be rejected.

Reflights

Unacceptable photo coverage resulting from deviations from the flight plan shall be corrected at the consultant's expense. The same camera and magazine shall be used for any reflights.

Leaders

There shall be an unexposed leader at the beginning of each roll of film at least 10 frames in length. Whenever the film is used in a discontinuous fashion such as a morning to afternoon flight, a section of unexposed film at least 4 frames in length shall be rolled forward prior to taking additional photographs. An unexposed trailer of at least 4 frames or more in length shall be included at the end of each roll or partial roll of film.

Regulations

It shall be the consultant's responsibility to observe and follow all Federal Aviation Administration regulations and to secure necessary permits or clearances for controlled or restricted airspace areas.

Mission Report

A daily flight summary or mission report shall be kept and submitted for all aerial photography flight missions. The report shall include but is not limited to the following:

- ?? project identification
- ?? date
- ?? names of pilots and photographers
- ?? weather
- ?? flight time

- ?? departure and arrival information
- ?? photography scale
- ?? altitude
- ?? camera settings such as f stop and shutter speed
- ?? camera identification
- ?? magazine identification
- ?? flight conditions such as crab and tilt in degrees
- ?? frame numbers and time photographed
- ?? other pertinent information

AERIAL FILM, FILM PROCESSING, AND REPRINTS

After the flight mission has produced properly exposed negatives, correct processing of the film is necessary to produce imagery in a consistent and interpretable form. In order to minimize image motion while exposing film, priority shall be given to maximizing shutter speed. Secondary consideration shall be given to the aperture setting and film speed.

Aerial Film

The MDT shall specify the type and brand of aerial film to be used for each project. The original processed negatives and associated copy rights shall be delivered to and become the property of the MDT. The film shall be professionally cleaned and placed in a sealed container immediately before delivery to the MDT.

Film Processing

The film shall be processed as soon after exposure as practical. Processing shall result in photography free of stains (chemical or other), scratches, and/or blemishes. The original processed aerial negatives shall be delivered to the MDT unstretched, undistorted, unscratched, unmarked, and free from fingerprints, dirt, or other blemishes. Developing streaks shall be minimized by attaching a ten-foot leader to the end of the roll before processing. Film shall be exposed and processed with a density range of 1.0 ± 0.2 as measured in the neat model areas of each roll, with minimum density of 0.40 above base fog. Base fog shall not exceed 0.24. Density measurements shall be made on a calibrated densitometer that has a 0-3.0 range.

Film Labeling

The lens serial number, platen serial number, time, and exposure number shall be exposed in each frame of the film. For cameras with electronic titling capabilities, camera settings including shutter speed, f-stop, and overlap settings shall be exposed in the film margins. Camera settings for cameras without electronic titling capabilities shall be provided in the mission report.

Film titles containing the project name, nominal photo scale, date, flight line number and consultant information shall be placed on the negatives after processing. The film shall be labeled so when positioned upright for reading, the flight direction is at the bottom of the photograph. Photographs shall be labeled using letters approximately 1/10 inch high. Refer to figure 2 for location of titling information:

Contact Prints, Diapositives, and Enlargements

Prints of aerial photography shall be made by the contact method or in the case of enlargements by the projection method. Contact prints shall be oriented emulsion to emulsion.

The processing (including exposure, development and fixation, and washing and drying) of all photographic material used in making photographic prints (whether contacts, reductions, or enlargements) shall result in finished photographic prints having fine-grain quality; normal, uniform density; and such color tone and degree of contrast that all photographic details of the photography from which they are printed show clearly in the dark tone areas and highlight areas as well as in the tones between. Adequate contrast grades of paper and proper laboratory procedures shall be used, as necessary to achieve the best prints possible. Excessive variance in color tone or contrast between individual prints will be cause for rejection. For best tonal quality, contact prints shall be exposed on an electronic dodging printer. Contact prints shall be sufficiently light to allow visibility of ink inscriptions.

All prints shall be clear and free from chemical stains, blemishes, uneven spots, air bells, light fog or streaks, creases, scratches, and other defects that would interfere with their use or in any way decrease their usefulness.

One set of contact prints with ground control locations marked thereon shall accompany each mapping photo project. Additional contact prints shall be ordered on an as needed basis.

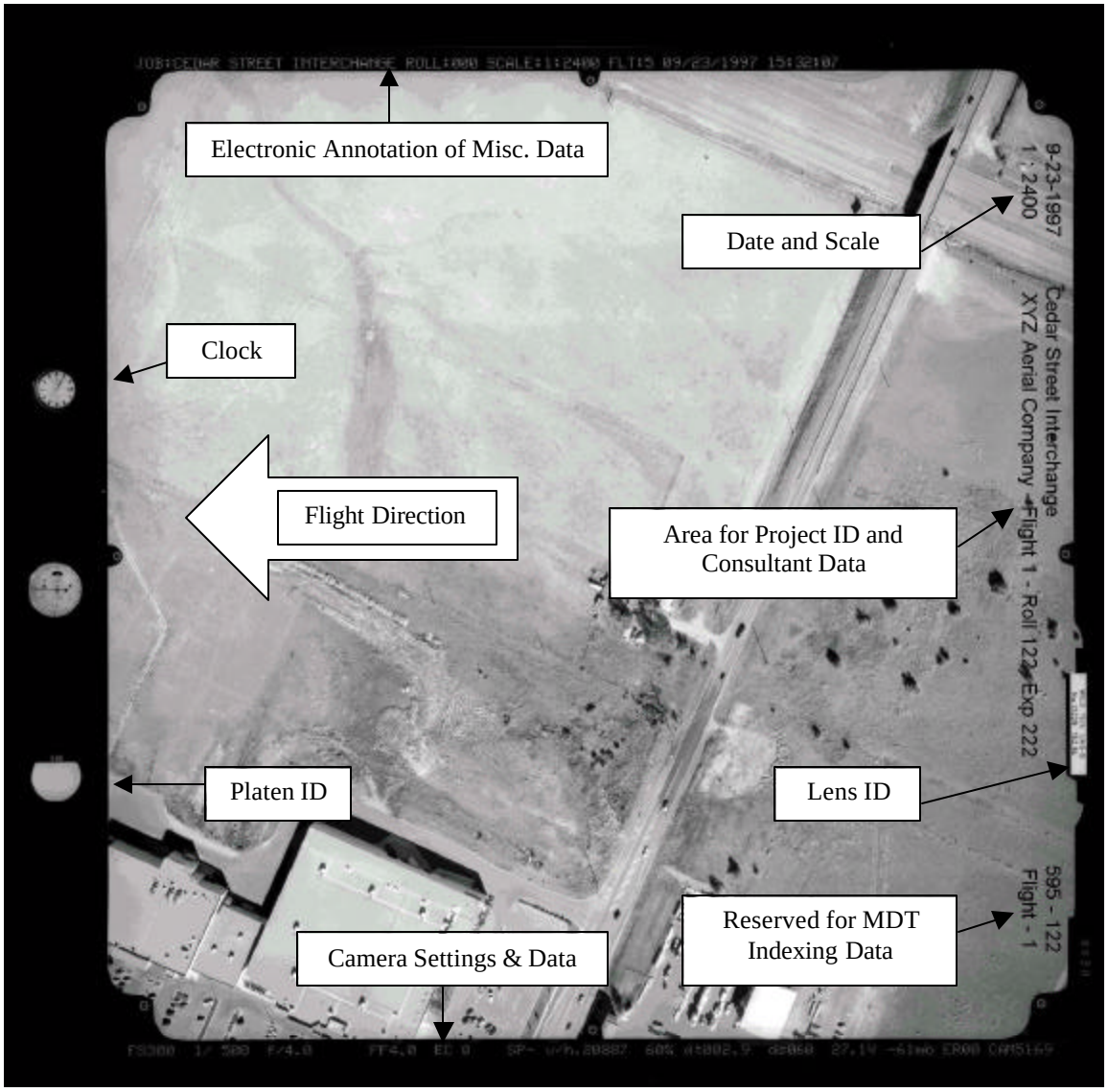

Figure 2

Digital Ortho Photos

Digital ortho photos shall be ordered on case by case basis with specifics accompanying each order.

Photo Mosaics

Photo mosaics shall be ordered on an as needed basis with specifics accompanying each order.

Film Index

The production entity shall prepare a film index for each roll of film. A paper copy of the index shall be taped to the film roll canister. An ASCII text file of the index shall also be supplied.

The index shall include the following:

?? name of photo consultant
?? county
?? project name
?? date of photography
?? photographic scale
?? frame numbers

(i.e. - MDT Air Photo Unit, Granite County, Beck Hill N & S, 4-22-2001, 1:6000, 122-145)

SECTION 2 – PHOTOGRAMMETRIC COMPILATION

GENERAL

The consultant shall perform specified photogrammetric services to complete required mapping. All photogrammetric mapping shall contain accuracy certifications within the title blocks of the delivered MicroStation files. In addition to this, a signed hard copy of the certification shall accompany each map file delivered.

The MDT shall furnish the consultant with one set of diapositives, one set of contact prints with ground control points marked thereon, one copy of the camera calibration report, a project schematic, a copy of the photo control coordinates from the ground control survey, and survey datum specifics. The MDT shall also designate the units of measurement to be used for mapping.

AEROTRIANGULATION

Aerotriangulation may be used to extend and densify photo control for mapping. All ground control points shall be used in final aerotriangulation solutions. No ground control points shall be dropped from aerotriangulation solutions without notifying the MDT. If points are dropped, remaining points must be sufficient to produce required accuracies. Any suspected errors with the ground control shall be reported to the MDT. The MDT shall investigate suspected errors and notify the consultant of the results. Aerotriangulation results shall be submitted to the MDT for review prior to commencing mapping.

MAP COMPILATION

Mapping products shall be submitted to the MDT in digital format on a CD. Map files shall be compiled in MicroStation using MDT CADD standards (ftp://ftp.mdt.state.mt.us/caddstd/). Terrain modeling shall be done using GEOPAK and MDT modeling guidelines.

The MDT will designate the area to be mapped on a map, a set of aerial photos, or in writing. A map scale and contour interval will be specified for purpose of accuracy certifications. The MDT shall request one or more of the following types of mapping: digital terrain model (DTM), planimetric, combined planimetric/DTM, or cross sectioning.

- DTM mapping shall consist of photogrammetric compilation of spot/mass points, break lines, boundaries, and void/obscure features to represent vertical relief. DTM mapping features will be used to create a TIN (triangulated irregular network) in GEOPAK. Contours and cross sections will be extracted from TIN files to be used in engineering studies and designs.
- Planimetric mapping shall consist of photogrammetric compilation defining the horizontal location of all natural and cultural features visible on the aerial photography.
- The combined DTM/planimetric map shall consist of photogrammetric compilation of both the planimetric and DTM features described above.
- Cross sectioning shall consist of photogrammetrically collecting data points at terrain breaks at specified intervals along an alignment. Cross section data will be used in engineering studies and designs. Output data shall be made available in several forms including: ASCII x,y,z file; ASCII station, offset, elevation file; and in a MicroStation file.

Mapping Details

Deliverables for DTM and planimetric mapping shall consist of the following files:

DTM Only	Plan. Only	DTM/ Plan.	File Name from CADD Standards	Description
x	x	x	****PHDTPZ%#.DGN	Digital Terrain/Planimetric Strip Map (3D)
x		x	****PHDTMZ%#.DGN	Digital Terrain Model (3D)
	x	x	****PHMAPZ%#.DGN	Planimetric Strip Map (2D)
x		x	****PHDTMZ%#.DAT	ASCII Source Input File for GEOPAK Triangulation
x		x	****PHDTMZ%#.TIN	GEOPAK Triangulation File

NOTE: In the file naming scheme **** represents the four digit MDT project number, the Z indicates it is a file developed by a consultant, the % will either be an F or an M representing project units (F=feet, M=meters), the # is used to indicate the file number

MDT CADD standards break photogrammetric mapping features out on the following levels:

Planimetric Levels

2 - Title Block
3 - Signs
7 - Non Categorized Plan Features
8 - Non Categorized Utility Features
9 - Vegetation
12 - Obscure Polygons
19 - Non Categorized Combination Plan/Break Line Features
23 - Man-made Drainage Features - Combination Plan/Break Line
25 - DTM Island Polygon
30 - Utility Features – Electrical
35 - Utility Features – Communication
36 - Utility Features – Potable Water Systems
38 - Utility Features – Drainage
51 - Photo Control Symbols
52 - Photo Control Text
63 - Coordinate Grid and Text

DTM Levels

10 - Mass Points
12 - Obscure/Void Polygons
15 - Boundary Polygon
19 - Non Categorized Combination Plan/Break Line Features
21 - Break Lines
22 - Natural Drainage Features - Combination Plan/Break Line
23 - Man-made Drainage Features - Combination Plan/Break Line
25 - DTM Island Polygon

The ****PHDTPZ%#.DGN file is the master mapping file. It is a 3D MicroStation file with all mapping data in it's actual mapped x,y,z position. The planimetric strip map file, ****PHMAPZ%#.DGN, is a file comprised of elements copied from the planimetric levels of the ****PHDTPZ%#.DGN file. These elements are converted into a 2D MicroStation file. Similarly, the ****PHDTMZ%#.DGN file is a 3D MicroStation file containing only the DTM mapping features copied from the ****PHDTPZ%#.DGN file.

Features from the ****PHDTMZ%#.DGN file are used to create the ASCII source input file, ****PHDTMZ%#.DAT, for GEOPAK triangulation by extracting feature information from the DTM levels as follows:

GEOPAK settings:
curve stroking tolerance = 0.1m
minimum linear distance = 2.5m

GEOPAK extraction features:
DTM Boundary – level 15
Obscure/Void Areas – level 12
DTM Island Polygons – level 25
Break Lines – levels 12, 15, 19, 21, 22, 23, 25
Mass Points – level 10

The triangulated irregular network file, ****PHDTMZ%#.TIN, is created in GEOPAK using the source input file.

Other mapping guidelines are as follows:

?? The ****PHDTPZ%#.DAT and ****PHMAPZ%#.DGN files shall contain a title block with project number id., project location id., project control number, contour interval, map certification, map scale, imagery used for mapping, date of imagery, date of compilation, name of mapping consultant, horizontal and vertical coordinate systems, and other pertinent information.

?? The ****PHDTPZ%#.DAT and ****PHMAPZ%#.DGN files shall contain a coordinate grid (250 m spacing)

?? Pass point data shall be plotted in the ****PHDTPZ%#.DAT and ****PHMAPZ%#.DGN files.

?? Ground control data shall be plotted in the ****PHDTPZ%#.DAT and ****PHMAPZ%#.DGN files.

?? The following list of cell attributes depicts scale size for cells placed at a fixed scale (ScaledFixed), identifies cells that are scaled to represent actual size (Scaled2pt), and identifies cells that are rotated to depict orientation (Rotated):

Code	Lvl	Col	St	Lw	Description	Props	Size	Command
13	38	1	0	0	Drop Inlet-Square	EDI		Rotated-Scaled2pt
19	36	1	0	2	Fire Hydrant	FH	0.5	Rotated-ScaledFixed
28	30	3	0	0	Guy Wire Anchor	ANC	1.0	Rotated-ScaledFixed
31	30	3	0	1	Light Pole	LP	1.0	ScaledFixed
32	7	3	0	0	Mailbox	MAIL		Rotated-Scaled2pt
44	30	3	0	1	Power Pole	PP	1.0	Rotated-ScaledFixed
52	7	3	0	1	R.R. Switch	RRSWT	1.0	Rotated-ScaledFixed
65	7	7	0	0	Storage Tank	TANK		Scaled2pt
69	35	6	0	0	Telephone Booth	TB	1.0	Rotated-ScaledFixed
77	30	3	0	0	Tower	TT		Rotated-Scaled2pt
78	30	3	0	1	Traffic Signal	TL	1.0	Rotated-ScaledFixed
81	9	2	0	0	Tree	TREE		Scaled2pt
105	38	1	0	0	Drop Inlet-Round	EDIR		Scaled2pt
107	8	7	0	0	Manhole	EMH	0.3	ScaledFixed
108	30	3	0	1	RR Crossing Light	RRCR	1.0	Rotated
109	8	3	0	0	Valve	VALVE	0.3	ScaledFixed
110	2	4	0	0	Title Block	TTB	1.0	ScaledFixed
111	7	7	0	0	Arrow	ARRD	1.0	Rotated
112	7	1	0	0	Swamp	SWAMP	1.0	ScaledFixed
124	13	3	0	1	Spot Height	SPOT	1.0	ScaledFixed
135	30	3	0	0	Utility Box	UBOX		Rotated-Scaled2pt
145	51	0	0	1	Control Point-Pass	PASS	1.0	ScaledFixed
164	51	0	0	1	Control Point-Full	FULL	1.0	ScaledFixed
165	51	0	0	1	Control Point-Horz	HORZ	1.0	ScaledFixed
166	51	0	0	1	Control Point-Vert	VERT	1.0	ScaledFixed

?? At times it may be necessary to depict features in the planimetric mapping that are not contained in or reasonably fit existing features in MDT's CADD standards features listings. If this occurs, these features shall be placed on either level 7, 8, or 9 depending on the feature type. The feature shall be drafted using simple linear or curvilinear attributes (no cells, custom line styles, etc.). Other symbology (weight, color, style, etc) shall be determined by the consultant. Symbology shall not duplicate other MDT CADD symbology. The consultant shall be consistent with the use of the custom symbology throughout the project

and shall annotate each custom feature throughout the project. A list of custom features and attributes shall be provided to the MDT by the consultant at the end of each project. Use of customized symbology shall be kept to a minimum.

Accuracy

In general the MDT will be proposing two mapping scales, 1:500 and 1:1000. Contour intervals associated with each will be 0.25 meters and 0.5 meters respectively unless otherwise designated.

On the finished map, the horizontal positions of at least 90 percent of well defined planimetric features tested shall not differ from their true position by more than 1/3000 of a unit at final map scale. No positions shall differ by more than 1/1500 of a unit at final map scale.

At least 90 percent of the spot elevations and elevations of features compiled for use in DTM modeling shall not differ from their true elevation by more than 1/4 of the specified contour interval. DTM features shall be collected on a spacing dense enough to allow for DTM modeling and generation of contours where:

?? 90 percent of the contours shall be within 1/2 of a contour interval and none shall be in error by more than a full contour interval.

In addition to this, DTM features shall be collected on a spacing dense enough to allow for extraction of DTM modeled cross section data where:

?? 90 percent of the cross section profiles extracted from the DTM model shall be in error by no more than 1/3 of the specified contour interval and no cross section profiles or segments thereof shall be in error by more than 1/2 of the specified contour interval.

A statement shall be included in the title block of each delivered mapping file certifying that the mapping and terrain modeling files meet the specified accuracies. The consultant shall be responsible for verifying accuracies. In addition to this, a signed copy of each accuracy certification shall accompany each map.

SPECIAL CASES

MDT's Photogrammetry & Survey Section Supervisor must approve any departure from or modification to the minimum specifications.

HYDRAULIC & HYDROLOGIC ASPECTS OF BRIDGE WATERWAY OPENING, IRRIGATION, AND DRAINAGE DESIGN

The Consultant will provide all hydraulic analysis and design necessary for the Project. This category of service includes hydrologic/hydraulic reports for bridges, design of project drainage and irrigation facilities, design of storm drain trunkline, inlets, and outfall facilities, evaluation of flood potential and risk assessment, and preparation and submittal of local floodplain permit applications, coordination and resolution of inquiries and receipt of approved permit as required. Details of required hydraulic features are also required. The design of

hydraulic features must be performed in accordance with the procedures outlined in the Department's adopted AASHTO Drainage Manual chapters and Department Design manuals listed above, in addition to considering current reference materials in the areas of bridge scour, stream stability, and fish passage. The Consultant will prepare and furnish Preliminary, Final, and updated Hydraulics Reports for Department review in accordance with the Consultant Flow Chart provided in the Department's Consultant Users Manual and Activity Descriptions.

GENERAL HYDRAULIC REQUIREMENTS

The hydraulic and hydrologic aspects of all drainage will be evaluated during the planning, location, and design phases of the Project. All sites, either in place on the present roadway or required on the new roadway, involving culverts, bridge waterway openings, irrigation ditches, channel changes, storm drain systems, and special requirements including riprap, guide banks, energy dissipators, and channel linings shall be subject to hydrologic and hydraulic investigations. Existing and proposed water related facilities shall be analyzed using Federal and MDT procedure and policy guidelines as outlined in the documents in:

Current policies and procedures recommended by the U.S. Department of Transportation in Federal-Aid Policy Guide, 23 CFR 650A, Location and Hydraulic Design of Encroachments on Floodplains, and the policies and procedures of the Department referenced in the next paragraph.

All work will be in accordance with the following AASHTO Drainage Manual chapters as modified and adopted by the Department. These chapters can be accessed on the Department's internet; Hydraulics Section:

- Chapter 7, Hydrology
- Chapter 9, Culverts
- Chapter 10, Bridges
- Chapter 13, Storm Drainage Systems

HYDRAULIC REPORTS

In addition, all crossings will be supported by documentation in the following general format: (A detailed list of tasks and documentation requirements for individual reports are included in the Consultant Users Manual and Activity Descriptions.)

Preliminary Hydraulic Report

This report will include the hydrologic and preliminary hydraulic analysis required to evaluate environmental impacts and establish the preliminary road alignment and grade.

Final Hydraulic Report

This report will update and supplement the preliminary hydraulic report to reflect modifications necessary as project design proceeds. All information and data included in the Preliminary Hydraulic Report will also be included in the final report. In addition, this report will include the economic analysis and comprehensive study for all proposed drainage and irrigation facilities and longitudinal floodplain encroachments for the highway facility. In addition, the report shall include a detailed summary, file documentation, and detailed recommendations.

Final Hydraulic Update

This report is an addendum to the Final Hydraulic Report and includes final documentation of permits, agreements, and hydraulic plan updates as a result of Plan-in-Hand inspections, right-of-way negotiations, and agreements. Field survey

recommendations and local historical information shall be included in the report; however, they are to be used only as guidelines. When other state or federal agencies or irrigation districts have facilities that conflict with the Project, the Consultant shall request approval of design details for relocation or modification of their respective facilities by letter and signed prints.

ENVIRONMENTAL

GENERAL

The Consultant will address and resolve all potential environmental issues, including but not limited to, social, economic, farmlands, 4(f) and 6(f), air quality, noise, cultural, solid/hazardous waste, groundwater quality and biological impacts, as applicable. This will include the preparation and distribution of all environmental documents, as well as all the research, testing, and coordination necessary to complete the environmental process. The Consultant will provide copies of supporting documentation to the Department. Draft copies of all environmental documents will be provided to the Department and FHWA for review and comment.

Environmental Document Preparation

The Consultant will research, coordinate, and prepare the environmental document for this Project in accordance with current State and Federal regulations. This will include the preparation of secondary documents as noted below and the incorporation of the applicable information, as well as any comments received from governmental agencies or other sources.

Biological Resources

The Consultant will evaluate the biological impacts of the Project. This will include coordination with the U.S Fish and Wildlife Service as necessary to obtain threatened/endangered species clearances, and coordination with the Montana Department of Fish, Wildlife and Parks and the Montana Natural Heritage Program regarding impacts to wildlife, fish, or species of special concern. The Consultant will prepare the Biological Resources Report, which will evaluate and resolve any biological, wildlife, and wetlands issues on the Project.

Cultural Resources

The Consultant will conduct a cultural resources survey for the Project and complete a Cultural Resource Report. The Department will obtain Section 106 clearance from the State Historical Preservation Office.

Cooperating Agencies

The Consultant will comply with the Cooperating Agency requirements under 23 CFR 771.111(d) if the Project uses or impacts property owned by a Federal or State agency.

Farmland Protection Policy Act

The Consultant will comply with the Farmland Protection Policy Act. This will include preparation of Form AD 1006 (the Farmland Conversion Impact Rating), and, if necessary, coordination with the Soil Conservation Service.

Environmental Permitting

The Consultant will prepare the applications for all environmental permits and clearances necessary for the construction of the Project (Clean Water Act Section 404 permits, Montana Stream Protection Act 124 permits, Section 402 Storm Water Permits, etc.), except for Section 106 clearance. All environmental permit applications will be coordinated through the Department's Environmental Services.

4(F) Involvement

The Consultant will identify any 4(f) involvement due to impacts on parks, recreational areas, or historical sites. This will include contacting the Montana Department of Fish, Wildlife and Parks, and if applicable, the U.S. Forest Service as per the Department's standard procedure. If a Section 4(f) Evaluation should be required, the 4(f) document will be prepared by the Consultant. Preparation of the 4(f) document and printing of copies would be an additional cost item.

Air Quality Assessment

The Consultant will prepare an air quality report for the Project or, if applicable, use the Department's applicable standard air quality paragraph in the environmental document. In the event that a regional and/or hot-spot analysis is required (through agency consultation procedures), the consultant will perform such studies working closely with the Department's Environmental and Planning Divisions, sate and local officials.

Hazardous Waste Assessment

The Consultant will address and resolve all hazardous waste issues on the Project. This will include coordination with the Montana Department of Environmental Quality, and testing, if necessary, to identify any hazardous waste sites.
The Consultant will perform a Phase I Hazardous Waste Study (Initial Site Assessment) as part of the initial Project scope. The consultant will make recommendations for a follow-up Phase II subsurface investigation (Preliminary Site Investigation), dependent upon the findings in the Phase I report and the scope of the project. The Department will review and consider the consultant's Phase II recommendations. If the Department agrees with and approves the Consultant's Phase II recommendation, the Consultant will submit a supplement to the task order and cost estimate to complete the work.

Noise Assessment

The Consultant will complete a noise study for the Project. This will include noise modeling and field verification in accordance with the Department's noise policy and federal regulations. Noise analysis must be done by qualified individuals with specific training in traffic noise analysis, measurement of highway traffic noise, and traffic noise computer modeling.

ENVIRONMENTAL COMMITMENTS, MITIGATION AND CONSERVATON

In order to ensure that a systematic, interdisciplinary approach is utilized in NEPA/MEPA decision-making and the Department is able to properly consider all environmental commitments, mitigation and conservation measures proposed for design projects by consultants in accordance with 23 CFR Part 777.5(a), the following procedure must be followed:

Submit a summary of all impacts with associated commitments, mitigation and/or conservations measures, along with corresponding justifications, purpose and need to the MDT Consultant Design Bureau for review, comment and approval prior to including those commitments, mitigation and/or conservation measures in any other document or report. The summary should be short and concise. If the commitments, mitigation and/or conservations measures are being proposed for listed or protected species, identify the species.

The prime consultant's lead project manager must also review these commitments, mitigation and/or conservation measures and approve of them by signing the summary document. By signing this summary the prime consultant is attesting that:

- The commitments, mitigation and/or conservation measures have been developed, refined, reviewed and concurred with, using an interdisciplinary team composed of Professional Engineers, road & bridge design engineers and hydraulic engineers, as well as professionals or specialists in social sciences, planning, safety, traffic; cultural, archeological, wildlife, natural resources and other disciplines as appropriate to the scope of the project and the potentially affected resources.

- That the commitments, mitigation and/or conservation measures are practicable 1, reasonable and prudent alternatives 2; and that they have been evaluated and determined to be "…in the best overall public interest based upon a balanced consideration of the need for safe and efficient transportation; of the social, economic, and environmental impacts of the proposed transportation improvement; and of national, State, and local environmental protection goals." 3

- That the impacts for which the mitigation is proposed actually result from the Administration [FHWA] action; and the proposed mitigation represents a reasonable public expenditure after considering the impacts of the action and the benefits of the proposed mitigation measures. [FHWA: 23 CFR Part 771, Sec. 771.105 (d) (1) & (2)]

Notes:
1 – The term **practicable** means available and capable of being done after taking into consideration cost, existing technology, and logistics, in light of overall project purposes. [FHWA 23CFR Part 777.2, also in 40 CFR Part 230, Section 230.3]
2 – The term **reasonable and prudent alternatives** means alternatives that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the action agency's legal authority and jurisdiction, that are economically and technologically feasible, and that the USFWS believes will avoid the likelihood of jeopardizing the continued existence of a listed species or the destruction or adverse modification of designated critical habitat. [ESA Section 7 Regulations – 50 CFR 402.02]
3 – FHWA: 23 CFR Part 771, Sec. 771.105 (b)

BIOLOGICAL RESOURCES REPORT

As part of the environmental review process described in the National Environmental Policy Act, Montana Environmental Policy Act, and the Endangered Species Act, projects must be analyzed as to their potential impacts on biological resources. The Montana Department of

Transportation (MDT) performs and requires these biological analyses in the form of Biological Resources Reports (BRRs), which address general biological resources, rare and sensitive species, threatened and endangered species (TES), and wetlands. Guidelines for conducting such analyses and preparing BRRs are provided below. Because the process is dynamic, coordination with an MDT biologist is suggested.

It should be noted that, in some cases, work may only be contracted out for a single biological resource, such as wetlands. In this case, the report does not need to include all sections discussed below. However, the report should stand alone, and should contain all information required under the appropriate sections, as discussed below.

General Reporting Guidelines

Analysis Areas - For vegetation, wildlife, and fisheries, analysis areas usually will extend outside project limits, and will be variable in size and location depending upon the species investigated. Analysis areas pertaining to wetlands are more specific and are discussed below under Wetlands.

Data Collection - Interview local experts; review applicable literature and current research projects; and conduct appropriate field surveys. With the exception of wetlands, methods employed during field surveys are to be determined by the Consultant, based on project and area specifics and professional judgment. Wetland delineation methodology is discussed below under Wetlands. It is important that all data collection methods be discussed/described in the BRR.

Report/Analysis - Include description of project, project area, analysis areas, and data collection methods. Include maps and/or photos, if appropriate. Discuss/describe existing biological conditions/resources. Evaluate potential direct, indirect, and cumulative impacts (past, present, and foreseeable future) resulting from the proposed project; identify measures to avoid, minimize, or mitigate projected impacts. Include documentation of pertinent correspondence with agencies or individuals. Reference sources appropriately.

Submit five (5) copies of complete final report to MDT. (Also required for reports done in-house if BRR is distributed to outside agencies.)

An example of a general BRR format outline acceptable to MDT is attached to these instructions. The format used on the attached outline is not necessarily required, but is provided as a general guide.

Specific Reporting Guidelines

The BRR addresses potential project-related effects to biological resources such as fish and wildlife species (game and non-game), habitats (winter range, spawning, etc.) and ecological communities (old growth, riparian, etc.). The report should include information specified under Reports/Analysis above, and should address general vegetation, wildlife, and fisheries (if applicable); rare and sensitive plants, wildlife, and fish; TES, and wetlands. Rare and sensitive species, TES, and wetlands are discussed below.

Rare & Sensitive Species Section This section specifically addresses plant and animal species designated as rare or sensitive or as species of special concern by the Montana Natural Heritage Program, Montana Department of Fish, Wildlife & Parks, or U.S. Forest Service. This section typically includes an overview of species status in the area and habitat

use; affects of the project on species or habitat; and measures to avoid, minimize, or mitigate for impacts. Specific surveys for pertinent rare or sensitive plants and animals will be conducted within the project or analysis area if deemed necessary by the consultant.

Threatened and Endangered Species Section This section analyzes effects of the proposed action and alternatives on species and habitats of species federally listed or proposed for listing as threatened or endangered. For consistency in semantics, this section will be entitled Biological Assessment and will only address listed or proposed TES and critical habitat. General guidelines for the process are outlined below.

USFWS Coordination For EA and Cat Ex level projects, coordinate with the appropriate MDT Project Biologist for the MDT District in which the project occurs to develop a list of TES and proposed TES that may occur in the project area. The USFWS may be requested to respond with a list of species that may occur in the area. A formal list must be requested from USFWS for EIS level projects. (For MDT BRR's done in-house, a formal request for a "list" is required only for EIS projects. MDT staff develop the "list" for Cat Ex and EA level projects.) Assessments are to address all the species listed. If no species are listed, an assessment is not necessary. The USFWS may also include additional information, such as habitat use by the species or an informal opinion that the project may or may not impact the species. This information can be incorporated into the assessment but can not constitute the assessment. A thorough assessment must be prepared and then reviewed and accepted by a MDT biologist.

Data Gathering/Assessment For each species, include: a status review; analysis of direct, indirect, and cumulative affects; a formal "determination of effect" of the proposed action; and identification of measures to avoid or minimize potential impacts. This requires field review(s), literature searches, and information gathering from land managers and researchers, including informal consultation with the USFWS. Based on the analysis of project impacts, one of four "determinations of effect" will be assigned to each species: "no effect"; "not likely to adversely affect"; "may adversely affect"; or "beneficial effect". These are discussed below.

- A No Effect determination occurs when a project or activity will not have any effect on a listed or proposed TES, or critical habitat.

- A May Adversely Affect determination occurs when a project is likely to adversely affect a listed or proposed TES, or critical habitat. If the determination is that the project may adversely affect a listed or proposed TES or critical habitat, then Formal Consultation with the USFWS must be initiated.

- A Not Likely To Adversely Affect determination occurs when a project may have possible "effects" on a listed or proposed TES or critical habitat, such as displacement or habitat modification, but those effects are insignificant or discountable.

- A Beneficial Effect determination occurs when a project is determined to substantially improve the habitat or status of a listed or proposed TES, or its critical habitat.

The BRR will be reviewed by a MDT biologist and, if appropriate, submitted to the USFWS for their review and concurrence regarding TES. (Required for EIS; discretionary for Cat Ex and EA level documents.)

Sample BRR Outline:

MONTANA DEPARTMENT OF TRANSPORTATION
Biological Resources Report

Project Name
Project and Control Number
Date

EXECUTIVE SUMMARY

INTRODUCTION

PROJECT AND GENERAL AREA DESCRIPTION

STUDY METHODS

AGENCY CONSULTATION AND LITERATURE REVIEW

FIELD SURVEYS

STUDY RESULTS

Terrestrial Resources
- General Description.
- Rare & Sensitive Species.
- Impacts.
- Mitigation/Coordination Measures.

Aquatic Resources
- General Description.
- Rare & Sensitive Species.
- Impacts.
- Mitigation/Coordination Measures.

Biological Assessment - Threatened and Endangered Species
- Wildlife.
  - Species (each species)
    - Analysis.
    - Mitigation/Coordination Measures.
    - Determination of Effects.
- Plants.
  - Species (each species)
    - Analysis.
    - Mitigation/Coordination Measures.
    - Determination of Effects.
- Conclusions.

Wetland Resource Inventory and Impact Assessment

Wetland Descriptions.
Impacts.
Mitigation.

REFERENCES

WETLAND RESOURCE INVENTORY AND IMPACT ASSESSMENT

The Consultant (or MDT staff biologist for in-house projects) will be responsible for conducting required wetland delineations and will make recommendations for necessary mitigation. This will include a Wetland Resource Inventory and Impact Assessment as described below.

A completed wetland resource inventory and impact assessment will minimally include the following:

1) Methods -

   Minimally a discussion of who did what, when, where, and how.

2) Description of Existing Wetlands -

   a) A description of the wetland resources in the project area, including types, extent, commonness, and wildlife/fisheries resource values (include a project translite, USGS quad map, or similar map summarizing on one map the location of each wetland site in relation to the whole project).

   b) A table summarizing the functional values of each wetland for which wetland site evaluation forms (see #5 below) were completed.

3) Wetland Impacts -

   a) A qualitative and quantitative description of the effect of new construction on each wetland or wetland complex. Identify and quantify actual wetland impacts (to the extent possible) for each highway alignment alternative being considered.

   b) A table listing affected wetlands, their type, area, affected area, site location and project Station location, and a summary of the total affected area of wetlands by category, type, and for the project.

4) Mitigation Alternatives -

   The consultant will identify mitigation alternatives in compliance with the MDT Interagency Wetlands Operating Procedure contained in the Interagency Operating Procedure for the Conservation of Wetland Resources Associated with Highway Construction Projects in the State of Montana (Interagency OP). A copy of the Interagency OP is available from the Department. Alternate mitigation sites will be located on a map and identified by Township, Range, and Section. An estimate of the potential area of mitigated wetland and the resultant wetland type will be given.

5) Delineation and Evaluation Forms -

Appropriate Corps of Engineers (COE) Data Forms and MDT Wetland Site Evaluation Forms (Rev. 05/99) for each wetland site identified on the project:

a) Identify all wetlands and wetland complexes within the proposed project R/W and within 100' of proposed project construction limits if wetlands are located outside the proposed project construction limits. Wetland delineations will be accomplished by application of the procedures currently in use by the COE at the time of the study.

6) Photographs and Maps -

a) Photographs representative of wetlands for which COE Data Forms and MDT Wetland Site Evaluation Forms have been completed.

b) A scale map of each wetland site for which wetland site determination and evaluation forms have been completed (see Site Maps below).

Wetland Site Determination and Evaluation Forms

Wetlands site determinations and evaluations will be completed by inspecting the project in the field and completing Department supplied Corps of Engineers Data Forms and MDT Wetland Site Evaluation forms for each wetland site identified. Wetland functional values will be assessed using the MDT Wetlands Assessment Methodology. The Department's Environmental Services will be notified prior to the consultant field inspections to allow for participation in the inspection if deemed necessary by the Department's Biologists.

Site Photographs

Photographs taken as representative of wetland site types for which site evaluation forms are completed, will be mounted on 8 1/2"X11" paper, and appended to the final report. The photographs should be taken with a 35mm camera, using color print film. A vantage point should be selected which will allow as much of the wetland as possible to be included in the photograph, while maintaining sufficient detail to discern the vegetation characteristics of the representational site. A site identifier (on erasable board, clipboard with paper, etc.), will be included in the foreground of each photograph, readable on the print, and referenced on the site evaluation form(s). Use of the highest f stop possible under the existing lighting conditions, a minimum shutter speed of 1/30 sec. (hand held), and a film with ASA in the 100-400 range will give good clarity of both foreground and background.

Site Maps

The following procedure will be used to create maps of each wetland site for which a wetland site evaluation form is completed:

1) Obtain scale plan maps for the affected area, if available.

2) If not already on the plan maps, draw in the toe-of-fill limits of the existing roadway and the new construction limits from cross-sections.

3) Using a zoom transfer scope, Map-O-Graph, or other suitable means, transfer delineated wetlands onto the map. Aerial photography may be used to supplement field mapping. If available, aerial photography may be obtained from the Department and

should be the same photography used for the project photogrammetry/design mapping effort. Photo scales of 1:6000 to 1:12000 are preferred.

4) Label each wetland type as listed on the wetlands site evaluation forms and shade the construction impacted wetland areas.

Attach or append the finished site maps to the completed BRR.

CULTURAL RESOURCE REPORT

The Consultant will be responsible for conducting a Cultural Resource inventory of this Project. The cultural resource inventory will be for the purpose of identifying and evaluating known or suspected cultural resource sites, and to determine the significance of the site by applying the National Register criteria as contained in 36CFR60. It may be necessary to suggest any mitigation measures.

Following the completion of a class III cultural resource inventory, the Consultant will prepare a written report of findings and recommendations. This report will be subject to approval by the Department and shall contain the following items:

1) Evidence of a thorough literature and records examination for previously recorded cultural resources.

2) The project translite/plans and USGS topographic map (or county road map) showing the area of the field inventory and locations of recorded sites in relationship to the highway.

3) A description of the field inventory methods used and an estimate of the reliability of the inventory (based on ground visibility).

4) A description of the highway undertaking and its area of potential environmental impact.

5) A brief description of the area and its environment.

6) An inventory of all cultural resources 45 years old or older which are located within the potential area of environmental impact. UTM coordinates and quarter-quarter-quarter sections must be included for all recorded sites. Sites should be marked on copies of USGS topographic maps. Every attempt should be made to draw site sketch map to scale. Computer-generated maps are preferred.

Completion of a "Montana Historical-Architectural Inventory Form" will be adequate for most historic structures. The following information about historic sites should be furnished:

- ?? physical description of each property
- ?? date of construction (within five years)
- ?? builder
- ?? use or function
- ?? historical content

Color photographs of the structure(s) and setting should accompany written descriptions. While all those photos need not be included in the report, they should be available as negatives and be included with the report. Photograph negatives of the structure(s) should also be included with the report.

7) An evaluation of resource significance according to the National Register criteria of eligibility.

Rationale should be provided as to why a property does or does not meet the criteria.

8) Especially for potential National Register eligible sites, site boundaries must be identified and justified. Both written descriptions and site sketch maps and/or project translites with site boundaries delineated will be included.

9) The report should include a brief discussion about potential rural historic landscapes in the vicinity of the project.

Five copies of the final report, including two with original photos, will be provided to the Department.

A Cultural Resource Annotated Bibliography System (CRABS) form will be prepared and submitted to the Department along with the final report, for SHPO use.

PUBLIC INVOLVEMENT

The Consultant will perform all public involvement activities for the project. The public involvement will be in general accordance with the Department's Public Involvement Handbook. The Consultant's public involvement will include at least one Public Information Meeting.

The Consultant will prepare and distribute a News Release for the Project. The News Release will be distributed to appropriate news media and to local individuals/organizations that have interest in or would likely provide input to the Project.

The Consultant will conduct personal contacts and hold meetings as required with local officials, government agencies, affected landowners, and interest groups, both for gathering input and for communicating final decisions.

The Consultant will prepare the visual aids and make the engineering presentations at all public meetings. The consultant will furnish display boards where the consultant is utilizing aerial photography and mapping.

The Consultant will contact agencies with requests for environmental information. Drafts of information request letters will be submitted to the Department for review by Environmental Services prior to being sent out.

TRAFFIC ANALYSIS

The Consultant will perform all appropriate traffic engineering required for the project.

The Consultant will prepare and submit to the Department for approval a Traffic Engineering Report. The Report will be prepared in accordance with the Department's Traffic Engineering Manual (Part 1- General) and will include warrants and recommendations for the traffic engineering features to be incorporated into the Project (lane numbers, left-turn bays, crosswalks, signals, lighting, intersection layouts, etc.).

The Consultant will perform a Signal Warrant Study to determine the requirements for signalization on the Project (both of the existing traffic signals on the route and of any need for additional traffic signals) and provide recommendations. The Signal Warrant Study Report may be incorporated into the Traffic Engineering Report or may be a separate report.

The Consultant will provide the necessary traffic counts (pedestrian counts, turning movement counts, etc.) as necessary to evaluate the design requirements noted above.

MATERIALS

The Consultant will perform the centerline soils survey and all geotechnical and other materials-related work as necessary to complete the Project.

The Consultant will conduct or will cause to have conducted all literature reviews, field surveys, field investigations, laboratory testing, and analyses required to provide full geotechnical recommendations and criteria for design of the Project. This work will include as necessary, but is not limited to, the following:

1. Soil surveys in accordance with Centerline Soils Survey (MT-207).

2. Geological field mapping and Geotechnical site review.

3. Geotechnical soil borings, exploration pits, and geophysical surveys deemed necessary by the Consultant, in consultation with the Department's Geotechnical Section, to sufficiently identify and characterize earth materials encountered during, or used for, construction of the Project. In general, explorations will extend to no less than 1.5 m (5 feet) below proposed subgrade elevation in cut sections, and in fill sections no less than the height of the fill or to a depth/strata where settlement and/or instability are considered to be insignificant. Soil borings will be sampled at intervals of 1.5 meters or less by means of a split-barrel sampler or Shelby Tube Sampler, as appropriate for the encountered conditions. Bedrock formations will be confirmed by drilling and recovering a minimum of 3.05 meters of HQ size or greater. All explorations will be documented with a formal log describing the soils and rock encountered by appropriate ASTM, USCS, or AASHTO methods and delineating stratifications, topsoil depth, first occurrence of ground water, phreatic water surface elevation at the completion of exploration, and all other observations having an influence on the Consultant's geotechnical recommendations.

4. Appropriate laboratory testing of soil and rock samples recovered during the field exploration to validate field observations and logging and to develop applicable design criteria and recommendations.

5. Necessary materials testing to evaluate earth materials to be used in construction of the Project. Where pipes, culverts, or other structural features are to be included in

the overall project, corrosion testing will be conducted for concrete, steel, and aluminum. All R-value testing will be conducted by the Consultant.

The Consultant will provide the results of the field studies, explorations, laboratory testing, and analysis in a formal report(s). This work will include as necessary, but is not limited to, the following:

1. Centerline Soils Survey (MT-207) plans at the Alignment Review, at the Plan-In-Hand Review, and for the final plans review. The Centerline Soils Survey plans will show sampling locations, depths, and soil properties/classification on the roadway plan-and-profile sheets.
2. Evaluation of surfacing alternatives and design of the recommended surfacing section(s). The surfacing design must be reviewed by the Department before incorporation into the plans.
3. A Geotechnical Engineering report detailing findings of the various studies and providing recommendations for backslopes, unstable foundations at all embankments and structures, roadway subgrade stabilization, subsurface drainage, shrink-swell factors, and design criteria for type, size, and depth of all structural footings/foundations at piers and abutments. Alternative design recommendations should be discussed and economic justification provided. The Geotechnical report will include the exploration logs, results of laboratory testing, and analytical calculations supporting the recommendations. The geotechnical report will identify and include consideration and analysis of the proposed project work on existing adjoining or nearby structures and facilities. The Geotechnical Engineering report will be prepared by and issued under the signature and seal of a duly registered Montana Professional Engineer having demonstrable experience and competence in the practice of Geotechnical Engineering.

The Consultant will meet with the Department's Geotechnical Section prior to beginning field explorations to review and discuss the Consultant's exploration and laboratory testing plans. Prior to submittal of the surfacing design, the Consultant will discuss the proposed design with the Department's Materials Bureau Surface Design unit. The Consultant will meet with the Department's Geotechnical Section to discuss the geotechnical recommendations prior to submittal of the final Geotechnical Engineering report.

The Consultant will prepare a Preliminary Geotechnical Work Plan showing relative starting and completion times (dates) for the proposed scope of work. Prior to beginning the geotechnical work, the Consultant, in consultation with the Department, will update and revise the Geotechnical Work Plan to accommodate the Department's Project Management System and to provide specific dates for meetings and deliverables.

If the Department is to provide the equipment and personnel to accomplish any or all of the exploration work, the Consultant will provide the plans and details of the work to the Department and will provide qualified field personnel to coordinate with the Departments crews, log the explorations, and take responsibility for all samples recovered during the exploration.

SURFACING DESIGN

DESIGN GUIDES

The Department follows guidelines set forth and supported by AASHTO. This includes the use of the 1972, 1986, and 1993 Guidelines. Future Guidelines will be added as they are officially adopted by AASHTO.

DESIGN INPUTS

The Department currently uses, as design inputs for its surfacing recommendations, the following:

1. R-value as reported from the Hveem R-value test performed in an accredited AASHTO lab
2. The MDT does not run R-value tests on A-6 or A-7 soils. MDT assumes the values equate to a five (5) R-value.
3. Traffic Equivalent Single Axle Loads (ESAL'S) as provided by the MDT Traffic Unit located in the Planning Division.
4. Soils Classification as reported from tests performed in an accredited AASHTO lab.
5. Resilient Modulus values
6. California Bearing Ratio (CBR) IS NOT used by MDT. However, MDT does recognize its use in any surfacing design submitted to the Department.

DESIGN HEURISTICS

1. In addition to the above listed Guides, on projects with one hundred (100) or less ESALs the Department consults the AASHTO Low Volume Design Guide.
2. Generally, the MDT does not consider a concrete (PCCP) alternative in rural areas unless requested by the District.
3. The MDT considers ultra thin whitetopping to be an experimental design at this time.
4. Recycled Asphalt (RAP) limit is 30% to 50% in the bottom lift and 10% maximum in the top lift of plant mix.
5. The use of milled asphalt material, outside of surfacing and roadway applications, must follow FHWA rules on assignment. These apply to the use or disposal of roadway millings. Millings are not generally used in "digouts" for Geotechnical reasons.

DESIGN TECHNIQUES NOT GENERALLY SUPPORTED BY MDT

The Department does not generally employ or support designs other than AASHTO. However, the Department recognizes that other proven surfacing designs are available to the consultant i.e. Asphalt Institute, Crush Stone Association, ACPA, etc. Therefore, before embarking on a course of surfacing design not generally supported by the Department, the Consultant should seek and get support from the Department for such surfacing design

NEW SURFACING DESIGN FEATURES

The Department recognizes and encourages theoretical innovation that this consultant process potentially provides the Department. Therefore, the Department supports innovative design concepts based on proven techniques where and whenever feasible. The Consultant should seek and get Department's support for these techniques prior to final design.

NON-HEADQUARTERS INFORMATION

The Consultant should also consider contacting Department's District engineering services personnel where the project is located. The Consultant will be able to gain valuable

local information on preferred construction techniques, materials, and other issues that may effect the Consultant's surfacing recommendation.

OTHER-SOIL RESISTIVITY TESTING

The method the Department is requiring to be used when reporting soil resistivity data used in corrosion analysis for buried metal is the Soil/Water dilution of 1:2.

RIGHT-OF-WAY

NEGOTIATIONS AND ACQUISITION

Right-of-Way Acquisition - General

The Consultant will provide professional services necessary to complete all authorized phases of right-of-way activity associated with this project.

All work will be performed in accordance with guidelines and procedures contained in the Montana Department of Transportation's Right-of-Way Manual and 49 CFR, "Uniform Relocation Assistance and Real Property Acquisition Regulations for Federally-Assisted Programs" as amended.

The Consultant will provide all necessary management to effectively perform the right-of-way activities authorized. This will include, but not be limited to, coordination of consultant field right-of-way personnel with the Department, responsible Section Supervisor, or designee to obtain all necessary approvals, review and approve all documents prior to submittal to the department, and maintain adequate records and files. Information will be maintained in separate individual files for each parcel.

The Consultant will provide to the Department on a monthly basis a statement indicating current status of all Right-of-Way activities. The status report will include parcel-by-parcel information. Activity completion dates are established as a part of this contract, and it is the responsibility of the Consultant to meet these dates unless otherwise agreed to in writing.

All consultant and consultant subcontractor field representatives, i.e., appraisers, negotiators, and relocation agents will be qualified and must be approved by the Department prior to assignments. All appraisers and review appraisers will be certified in the State of Montana. The type of certification required will be determined by Department based on the complexity of the assignment.

The Consultant will be responsible for obtaining advice from their attorney on all legal matters such as interpretation of entities concerning ownership, local governmental regulations, or any local matters not covered in the Right-of-Way Manual or unavailable to the Department. Prior approval from the Department is required for use of a consultant attorney regarding right-of-way acquisition on this project. Any request for legal advice or opinion from the Department's legal staff will be in writing and sent through the Right-of-Way Bureau.

Should condemnation proceeding be required, the Consultant will be expected to provide the Department with the necessary witnesses for expert testimony at the request of the Department's Legal Services.

Acquisition Requirements

As a minimum, the following items are performed by the Consultant as a part of the right of-way acquisition depending on the phases authorized:

Title - Title evidence is required for all right-of-way parcels to be acquired. The Consultant is responsible for updating all titles and providing necessary documents to show ownership of property to be acquired. Obtaining adequate interest in property is absolute, and clearing of all encumbrances is necessary.

Deeds and Exhibits - Proper deeds, easements, and exhibits will be prepared by the Consultant in a form acceptable to the Department. The Consultant will prepare all Deeds, Exhibits and description of taking (for condemnation parcels) in accordance with the Department's current practices and procedures, with the first three Deeds and Exhibits submitted to the Right-of-Way Bureau for checking of format and procedure prior to the Consultant preparing the remaining Deeds. The Consultant will make arrangements through the Right-of-Way Bureau for project personnel to take a 2-4 hour instructional class on the Right-of-Way Plan Revisions and Deed Preparation. This requirement is mandatory for all Consultant personnel who will be working on the Right-of-Way Plans.

Plan Revisions - Any proposed revisions to Right-of-Way Design after Authorization to Acquire will be reviewed and acted on by a committee comprised of representatives of the Consultant, MDT Consultant Design, Negotiation, Utility and Right-of-Way Design/Plans Sections prior to any revisions to the Right-of-Way Plans.

Property Owner Contact - Prior to performing on-site appraisals, the Consultant will send a notice to affected property owners informing them of the state's intent to acquire the property or a portion of the property in their ownership. The notice will include:

- General information about the proposed project.
- Description of the procedures by which the state will acquire the property.
- Information regarding the owner's right to accompany the appraiser on the inspection.
- The name and telephone number of a contact person who can answer questions and provide further information.
- Appropriate relocation assistance references where applicable.
- A copy of the Department's information pamphlets regarding state acquisition of private property for highway projects.

Project Report or Sales Catalog and Property Appraisal - Prior to the commencement of appraisals, a Project Report or Sales Catalog will be completed by the Consultant and approved by the Department. The Project Report or Sales Catalog will be approved by the Department prior to acceptance of the value determination or appraisal. Value determinations and appraisals will be prepared in accordance with federal and departmental guidelines. Value determinations, where market value is estimated to be

less than $5,000, are prepared by the Consultant's appraiser. Appraisal reports must be approved prior to acceptance of value determination by the Department.

The appraisal report will, at a minimum, include the following, and adhere to Chapter 5, Appraisal, MDT Right-of-Way Manual:

- Purpose of the appraisal, definition of interest being appraised, and Statement of Assumptions and Limiting Conditions.

- Description of physical characteristics of property being appraised, including known encumbrances, title information, location, zoning, present use, analysis of highest and best use, and minimum five years sales history of the property.

- Relevant approaches to value: cost, income, and market including analysis and correlation of approaches to value, and an explanation of the final conclusion of value when more than one approach is utilized.

- Description of comparable data including information regarding physical, legal, and economic factors, parties to the transaction, source and method of financing, and verification of acquired data.

- A statement of the Current Fair Market Value of the real property to be acquired including damages and benefits, if any, to the remaining real property.

Departmental appraisal formats and forms will be used to the greatest extent possible. A history documenting contacts with the landowners will be included with each appraisal report.

The Consultant will assure that the property owner or his designated representative is given an opportunity to accompany the appraiser during the appraiser's inspection of the property. Such invitation will be made in writing with sufficient lead-time for the owner to arrange to be present or request an alternative time. Certification of such is to be included on the appraisal form.

Outdoor Advertising - All legal off-premise signs within the acquisition are to be appraised by the Consultant's appraiser, reviewed, and acquired in accordance with Montana's Right-of-Way Manual. On-premise signs will be appraised as a part of the realty.

Negotiations - The negotiator will make all reasonable efforts to personally contact each property owner to make an appointment at a time and place convenient to the owner. If an owner is outside the area or state, negotiations may be conducted by Certified Mail at their request.

On the first contact, a written offer will be presented to the owner along with a summary statement of the basis for the offer.

The owner will be given reasonable opportunity to consider the offer and present material which the owner believes is relevant to determining the value of the property and to suggest modification to the proposed terms and conditions of the purchase. All concerns of the owner will be given consideration and made a part of the negotiation

history. Concerns outside the limits of the negotiator's authority or knowledge will be referred to the Department.

There will be a sufficient number of personal contacts with each landowner to adequately settle the parcel or clearly indicate that an impasse has been reached and further contact would be unproductive. In the event of outstanding differences, the Consultant will continue negotiations with the owner in an effort to resolve these differences.

No settlements in amounts greater than the approved offer of Fair Market Value will be offered an owner without written approval of the Department. Recommendations for settlements above the approved market value will be accompanied by negotiation histories.

At such time as the Consultant and the Department agree an impasse has been reached with the owner, the Consultant will submit to the Department parcel files and any other relevant data required by the Department for preparation of final offer letters.

Barring positive response to the final offer letter by the property owner, the Consultant's responsibilities in regard to the right-of-way acquisition for the parcel will terminate other than providing expert testimony in condemnation proceedings.

Timely and adequate written records of all negotiations will be made on a parcel-by-parcel basis. The information for each contact will include a detailed narrative account of what transpired. The records will include:

? Date and place of contact.

? Parties of interest contacted.

? Offers made (dollar amounts).

? Counter offers.

? Reasons settlement could not be reached.

?? Feedback and concerns from property owners.

? Signature of negotiator.

When negotiations are successful, a signed statement prepared by the negotiator shall certify that the written agreement embodies all considerations agreed to, that the acquired property is for use in conjunction with the federal-aid project, that the negotiator had no direct or indirect interest in the property, and that the agreement was reached without coercion of any type. The completed parcel, including the original Deed, Right-of-Way Agreement, and any partial conveyances, trust indentures, etc., will be submitted to the Department for review, approval, and processing of payments as specified in the Right-of-Way Agreement.

RIGHT-OF-WAY PLANS PREPARATION

Ownership Report
The ownership report needs to include the last deed of record and color coded ownership map for all ownerships adjacent to the highway from the beginning of project to the end of project. An estimate of right-of-way acquisition and relocation costs also needs to be included.

Title Commitments
Title Commitments are required for all parcels when right-of-way or easement is being acquired from a property owner, excepting Non-patented and railroad land.

Three sets (1 original and 2 copies) of parcelized title commitments are required when final right-of-way plans are submitted to MDT for checking. All supporting documentation is to be attached to the title commitment. A complete full size set of C.O.S's and subdivision plats are also required.

Access Control Study
When access control is proposed for the project, an access control study will be conducted by the Consultant and copies submitted to the Department.

Irrigation Study
If construction is likely to impact irrigation facilities on adjacent properties or when irrigation facilities cross the project corridor, an irrigation study will be conducted. The irrigation study will include all items indicated in Task 4 of PMS Activity 110 (see Consultant Users Manual & Activity Descriptions).

Relocation Assistance Study
If any relocations are anticipated on the project, a Relocation Assistance Study may be required.

Existing Highway and Railroad R/W Plans and Documents
It is the consultant's responsibility to request the existing R/W plans by R/W project number. It is also the consultant's responsibility to obtain railroad plans and documents of conveyance for the existing highway right-of-way. The Department's Right-of-Way Bureau will provide the Consultant with copies of these plans upon request.

R/W Design
New right-of-way design is to comply with the Engineering Division Policy & Procedure memorandum on Uniform Right-of-way Widths dated 1-1-01.

New easements will be required for channel changes and in areas where the new facility is serving someone other than the owner where the facility is being constructed.

Construction permits are to be used for inlet/outlet ditches and approaches going 15 m (50 ft) beyond the right-of-way.

Existing Right-of-Way or Easement

The type of interest, right-of-way (fee) or easement, is to be identified on the right-of-way plans. A Retracement Survey performed by a PLS is needed to retrace either the existing right-of-way or easement to be utilized or where it ties into the new right-of-way. The appropriate information is to be placed on the R/W plans.

R/W Plan Revisions

The Consultant will make all changes to the Right-of-Way plans resulting from final design or negotiations with the landowners in a timely manner and in accordance with the Department's Plan Revision procedure. The Consultant will provide the revised Right-of-Way plans (CADD Files) along with a detailed description of revisions (Form 111A) in electronic format. The Department will complete the distribution of revised plans prior to the revised deeds and exhibits being issued to the Right-of-Way Agents.

Exhibits for Acquisition

All exhibits necessary for acquisition, including exhibits for railroad acquisition, will be prepared by the Consultant in accordance with the Department's current practices and procedures. Exhibit CADD files are to be submitted with the final Right-of-Way plans for checking.

R/W Plan Revisions for Condemnation Parcels

The Consultant is responsible for all R/W plan revisions and the preparation of acquisition exhibits necessary for condemnation parcels. It is also the Consultant's responsibility to have the title company convert the Title Commitment to a Litigation Guarantee and to forward the original Litigation Guarantee to the Department.

ADVANCED ACQUISITION PARCELS

Total Acquisition

It is the Consultant's responsibility to provide Parcel Numbers and Title Commitments with supporting documentation upon request from the Department.

Partial Acquisition

It is the Consultant's responsibility to provide Parcel Numbers, Title Commitments with supporting documentation and R/W plans suitable for recording with County Clerk and Recorders upon request from MDT.
Note: R/W plans suitable for recording may not be available at this stage of the project.

Section Corners

Whenever a section line crosses the centerline, the appropriate corner on each side will be required to be tied into the control traverse.

Right-of-Way Monumentation and/or Property Corners

Retracement Surveys (surveys of property corners and right-of-way monumentation, necessary for the retracement of the existing right-of-way) will be required when existing right-of-way is to be utilized or where new right-of-way is to be tied into the existing. These surveys are to include a Certificate of Survey. The property corners and right-of-way monuments are to be shown on the right-of-way plans. All surveys involving section corners, property corners and right-of-way

monumentation are to be performed by a PLS and done in accordance with the MDT Survey Manual.

CADD Files

The right-of-way CADD files are to be built in accordance with the current Department practices utilizing the Department's Cell Libraries, level assignments and reference file procedures, which include file naming.

Submittals

All submittals to the Department are to be in accordance with the MDT Consultant Users Manual & Activity Descriptions.

CADD REQUIREMENTS FOR BRIDGE PLANS

Submit each drawing to the Department in two forms: "hard copy" reproducible drawings bearing the Licensed Engineer's seal and signature, and in electronic form. The electronic submittal may consist of files on 3 ½ - inch diskettes formatted to 1.44 megabyte capacity or on CDROM. Use PKZIP® version 2.04g for file compression in the event that compression is desirable. Prepare all drawings using Bentley Microstation version 5.07.00.35 (Microstation SE) or later.

The Department maintains an anonymous ftp site at *ftp.mdt.state.mt.us* (also accessible from the MDT World Wide Web site at: *http://www.mdt.state.mt.us*). The */caddstd/brstd/seed/* directory contains Microstation seed files† for downloading that match MDT standards. Those seed files meet the CAD file formatting requirements below.

The electronic form of the file submittal must meet all of the following requirements:

1) Use only Bridge Bureau seed files to create project CAD files.

2) Follow MDT *CADD Standards* manual conventions in naming files.

3) Place only one drawing in each file.

4) Place all reference files a drawing uses within the file containing the drawing.

5) Draw details at full scale and reference them into a full-size border to print at the appropriate scale.

6) Enter note text using Font 16 and enter title text using Font 15. Use a scale appropriate to produce note text characters 3 mm (1/8 - inch) high and title text characters 5 mm (3/16 - inch) high after referencing them into the drawing border at the scale selection and printing them in a full-size print.

† Use *seed.dgn* for projects in English units and *seedm.dgn* for projects in metric units.

7) Use only pattern commands, area-fill commands, or placing elements to fill drawing areas that require a pattern.

8) Use the following line-weight hierarchy (in order of increasing line weights), with a difference between adjacent line weights dramatic enough to be readily visible on a full-size print:

   a) dimension lines, centerlines, and section symbology (line weight = 0)
   b) hidden lines, notes and dimensions text, reinforcement steel, and contour lines at minor contour intervals‡ (line weight =1)
   c) object lines too close together to avoid blurring at a heavier line weight (line weight = 2)
   d) all other object lines, contour lines at major intervals, and title text. (line weight = 3)

9) Assign drawing elements to levels following the order:

   a) Level 1: object lines, centerlines and hidden lines
   b) Level 2: text and dimensioning
   c) Level 3: riprap
   d) Level 4: profiles and contours
   e) Level 5: reinforcement stee
   f) Well in advance of the final submittal, provide the Department at least four drawings in both electronic form and in printed form. The Department will use this submittal to verify that the Consultant's electronic files will print exactly as they appear in the printed submittal. If the drawings fail this test, modify the CAD drawing preparation method until the two forms of each of the four drawings match.

The Department uses Microstation *PLOT* to plot drawings. MDT uses the plot configuration files:

- *half.plt* for 11 in. x 17 in. plots. Select the green dots on the drawing border to set the plot fence.
- *full.plt* for 24 in. x 36 in. D plots. Select the purple dots to set the fence.

The Department makes these two files available on its *ftp* site in the */caddstd/plotting/* subdirectory. Include a copy of *resetej.txt* in the download at the same time and store it in the plot driver directory on your system.

CONTRACT PLANS

GENERAL

The Consultant will furnish the following plans (including title sheets, typical sections, and summaries) as applicable: construction plans, bridge plans, cross-sections, right-of-way plans, utility plans, lighting plans, geometric/signalized intersection layouts, signing and pavement marking plans, landscaping plans, and erosion control plans.

‡ Insert major contour interval lines at 5 ft. intervals and minor ones at 1 ft. intervals in projects in English units. Insert major contour interval lines at 2.0 m. intervals and minor ones at 0.5 m. intervals in metric unit projects.

The Consultant will furnish necessary prints of plans required to develop the Project. Prior to submission of plans for each stage of Project development, the Consultant will consult with the Department regarding the exact number of full and half-size sets of plans to be furnished.

CADD DESIGN

All design will be performed utilizing Microstation and GeoPak. The data will be put on a CD or 3½" high-density, double-sided disk in .DGN format. No conversions or translations will be allowed. Translation from any other CADD platform including any CADD exchange files will not be acceptable. All earthwork design will be completed in GeoPak.

The Consultant will utilize the Department's guidelines found in the MDT CADD Standards Manual for level assignments in CADD. All information on the plans will be placed on the assigned levels. Production of the Roadway and Right-of-Way Plans will follow the MDT CADD Standards Manual. The Department's Consultant Design Section and Right-of-Way Bureau will provide a biannual instruction class on proper CADD procedure. Attendance is mandatory for all consultant personnel working on project plans.

All material generated on the Consultant's CADD system is required with the final submittal. In addition, the final construction plans will be submitted in one complete set of reproducible plans.

All plan submittals at all stages of project development will consist of the specified number of hard copies of the plans accompanied by a disk or CD containing the appropriate GeoPak and Microstation computer files for the submitted plan information.

All final submittals, including reference files will be 2D. All file names will correspond to the naming conventions as contained in the Road Design Manual. The Department's CADD standards must be adhered to. No consultant-generated substitutes to the CADD standards will be accepted. Failure to comply with this convention will cause the plans to be rejected and returned for correction.

ROADWAY PLANS

Roadway plans will be prepared at a scale compatible with Department procedures (standard scales in metric are 1:500 for urban and 1:1000 for rural roadways) and dimensioned for construction, drainage, and intersection layouts. The Consultant will meet with personnel of the Department's Consultant Design Section to discuss requirements to meet metric standards and sizes for plans. The Consultant will use the Department's current plan cells found in the MDT CADD Standards Manual for the contract plans. Such plans will show all existing topographic features, surface, and subsurface facilities as indicated by the Department or utility company records for the area included in the proposed right-of-way. The contract drawings will be furnished on reproducible material (laser quality prints or approved equivalent) in both full-sized and half-sized scales as well as computerized plan sheet files on computer disks and will be complete in detail for all construction in accordance with current design practices of the Department found in the Department Manuals listed in Article I, Section 3 for preparation of Federal-Aid plans. Basic computations will be made for alignment and for layout of structures and intersections.

The plans will include title sheets, typical sections, summaries, plan and profile sheets, intersection layouts, details, drawings, etc., for grading, surfacing, drainage, etc., and all other necessary items. Fencing frames, as applicable, shall be included in the summaries.

As soon as possible, the Consultant will furnish plans for the Alignment Review, conduct the Alignment Review, and submit the Alignment Review Report to the Department for approval.

Promptly after approval of the Alignment Review Report, the Consultant will begin preparation of a detailed Scope of Work Report. The report will describe the proposed scope of work, design parameters, project limits, special features, etc. of the Project. The Scope of Work Report will then be submitted to the Department for approval.

As soon as possible after approval of the Scope of Work Report, the Consultant will furnish plans for a plan-in-hand, hold the Plan-in-Hand Review, and submit a Plan-in-Hand Review Report to the Department for approval.

The Consultant will then proceed with the design until the Project is ready for a Final Plan Review. At such time the Consultant will furnish plans for the Final Plan Review, hold the Plan Review and submit the Final Plan Review Report to the Department for approval.

Where privately, publicly, or cooperative-owned utility companies (other than railroads) will require rearrangements in connection with the proposed construction, the Consultant shall advise the Department as to who owns the utilities, both overhead and underground, the number of wires, line capacity and voltage of power lines, and pipe sizes and type. If necessary, the Consultant may contact the owners regarding their facilities. However, the Consultant will make no commitments with the utilities binding upon the Department. The Department will conduct all negotiations with the public utilities and authorities; however, the Consultant will participate in such negotiations at the request of the Department.

When a railroad alignment or railroad right-of-way is in conflict with the proposed construction, the Consultant will advise the Department as soon as preliminary design is complete of the areas of conflict. The Department will coordinate with the affected railroad as necessary to gain approval of the preliminary design or get any revisions necessary in order that the Consultant may proceed on final design of the area in conflict. If any railroad relocation is required, the preparation of all plans for this relocation shall be considered as extra work, and a fee for the work shall be agreed upon before the Consultant proceeds with the design.

Cross sections will be prepared as prescribed by the Department (standard horizontal and vertical scale are 1:100).

Project-specific special provisions will be prepared by the Consultant for all items not covered by standard/supplemental specifications of the Department. Draft versions will be furnished for the Plan-in-Hand and Final Plan Reviews. The final submittal will consist of 1 original and 1 copy and a disk or CD containing the submitted material using MDT compatible software. The preferred software is Microsoft Word. Other acceptable software would be an ASCII file. Use CD's or 3½" high-density disks.

Estimates of quantities and construction cost will be prepared by the Consultant and itemized and properly symbolized in accordance with the Department's Standard Specifications on the basis of current materials, labor, and construction costs using statewide average unit bid prices or other costs furnished by the Department.

Contract plan prints, special provisions, and estimates will be submitted by the Consultant to the Department for checking before final contract plans are submitted. Final reproducible hard copies and electronic files will be submitted upon completion of all design.

Final designs will be accomplished for all drainage and irrigation facilities. Plans for headwalls or other minor structures will be considered as special details of the roadway plans and will conform to the MDT references in Article I, Section 3 of the Agreement.

The Consultant shall prepare the necessary plans and special provisions for detour roads and traffic control.

The Consultant will prepare the plans for any required retaining walls (pre-cast, wire, bin, etc.). Any retaining walls required would be an additional cost item.

The roadway plans will contain all required plan sheets, summaries, details, cross-sections, signing plans, striping plans, etc.

BRIDGE PLANS
The Consultant will prepare all necessary bridge plans for the Project. See "CADD Requirements for bridge plans" Section.

SIGNING AND PAVEMENT MARKING PLANS
The Consultant will prepare the necessary plans for signing and pavement markings in conformity with the MUTCD.

RIGHT-OF-WAY PLANS
Right-of-way plans, as required, will be prepared by the Consultant in accordance with the current design practices of the Department for preparation of such plans found in the MDT Road Design Manual, the MDT Right-of-way Manual, the MDT CADD Standards Manual, and the section of this Appendix entitled Right-of-Way Plans preparation.
The Department will furnish to the Consultant, as available, prints of the existing right-of-way plans. It is the Consultant's responsibility to obtain deeds covering any existing highway right-of-way.

The Consultant will furnish right-of-way CADD files concurrent with the conduct of the work and services set forth in this Agreement and in accordance with the following guidelines:

- Prior to the plan-in-hand, the Consultant will furnish the Department CADD files of the right-of-way plans. These files should show, at a minimum, the centerline of the proposed construction, proposed right-of-way limits, existing railroad and highway right-of-way lines, section lines, 1/16 lines and quarter calls, ownership lines, parcel numbers, and relative topography.

- The Consultant will advise by letter areas where the proposed roadway may be in conflict with the existing utilities and railroad facilities.

- After the Plan-in-Hand Review when the construction limits of the Project are reasonably finalized, the Consultant will promptly complete the final right-of-way plans and furnish CADD files to the Department for checking. The Consultant will submit all necessary supporting data along with the right-of-way and utility CADD files, including title memos, all last instruments of conveyance, Certificates of Survey, and subdivision plats. The plans will include the completed right-of-way limits with total ownership information and access management features.

- After MDT approval of the right-of-way and utility plans, the Consultant will furnish CADD files of the right-of-way and utility data. He will also furnish, at the same time, three sets of current (updated) construction plans, utility plans, and two sets of cross-sections showing utility topography.

The Consultant will furnish one complete set of right-of-way plans when the proposed highway right-of-way encroaches on railroad property. The plans will be furnished as soon as the Consultant has made revisions and final right-of-way check. The encroachments will be indicated on one half-size set of the plans as follows:

- New and existing easements - Shaded with Dot Pattern
- Temporary permits – Hatched
- License - Cross-hatched

In addition, the Consultant will furnish 2 half-size sets of prints of the roadway construction plans. These plans will include the title sheet, typical sections, summaries, all data and detail sheets, as well as plan-and-profile sheets and cross-sections covering each encroachment area plus 200 feet before and 200 feet beyond each encroachment area.

The Consultant will submit one full set of final right-of-way plans.

The Consultant will make all routine changes to the Roadway Plans and Right-of-Way Plans resulting from right-of-way negotiations. Routine changes would not include adjustments to alignment (horizontal or vertical) or mainline typical sections. Routine changes would typically consist of adjustments to approach locations/configurations or minor adjustments to right-of-way layout. The need to make these changes may occur after the final roadway and right-of-way plans have been accepted by the Department. All revisions to the right-of-way plans after the Department has authorized the Project for acquisition will comply with the Right-of-way Bureau's revision process.

UTILITY PLANS

The Consultant will show on the plans and cross-sections all public and private utilities that are in the project corridor, as located and surveyed in accordance with MDT SUE requirements.

Utility plans will be prepared by the Consultant in accordance with the current design practices of the Department for preparation of such plans, found in the MDT Road Design Manual and the MDT CADD Standards Manual, and will call out all utilities in conflict with the Project. Utility plans are a duplication of the right-of-way plans with the utility topography levels turned on, as outlined in the Reference File Scheme. The plans shall include new right-of-way, existing right-of-way, construction limits (both cut and fill), utility topography with utility conflicts circled, and utility crossing stations with overhead clearance or depth indicated. CADD files shall be provided.

Prints of utility plans will be furnished to the Department as required. After all necessary revisions and corrections have been made, the revised plans will be submitted to the Department for use in obtaining Utility Agreements. One set of final utility plans will be submitted at the same time that final right-of-way plans are submitted.

The final utility plan submittal shall consist of the CADD files, one set each of the utility plans, cross sections with all utility topography shown thereon, construction plans (complete with plan and profile, summaries, pipe locations and typical sections), signing and pavement marking plans, and electrical plans.

LIGHTING PLANS

The Consultant will design and furnish the necessary lighting plans for the Project, as determined by the approved Traffic Engineering Report.

SIGNALIZATION PLANS

The Consultant will design and furnish signalization plans for all intersections where signals (including existing signals) are warranted as determined by the Consultant's approved Signal Warrant Study Report.

LANDSCAPING PLANS

The Consultant will design and furnish landscaping plans as necessary.

EROSION CONTROL PLANS

The Consultant will design and furnish the Erosion Control Plans for the project in accordance with the Department's current policy found in the MDT CADD Standards Manual.

FINAL PLANS ACCEPTANCE

The Department will not accept the Final Plans until they have been successfully printed on the Department's Printing System.